COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCE AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	**TAO -203**	**SEMESTER**	**2**
COURSE TITLE	**PRINCIPLES OF IMAGING**		

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 THIS COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

(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 will be able to:
• Know the basic theoretical principles governing the detection, analysis and creation of an image using electromagnetic radiation.
• Know the basic principles of image reconstruction using inverse problems
• Know the basic operating principles of optical microscopic imaging methods
• Know the basic operating principles of optical macroscopic imaging methods
• Know the basic operating principles of medical imaging methods

- Be able to independently describe and solve imaging problems

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 7.

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 Decision-making	*Respect for difference and multiculturalism*
Working independently Teamwork	*Respect for the natural environment*
Working in an international environment	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Working in an interdisciplinary environment Production of new research ideas	*Criticism and self-criticism*
	Production of free, creative and inductive thinking .....
	Others...
	.....

- Capacity to address complex problems.
- Development of scientific thought
- Use of the University Library and multiple bibliographic references
- Searching sources, simulations, and electronic courses on the internet
- Taking notes and development of independent methods of studying
- Writing research reports
- Efficient management of time and deadlines
- Development of the ability to present concepts in a succinct form

(3) SYLLABUS

1) Theoretical foundations of Imaging

Introduction

a) Basic concepts
b) Image acquisition
c) Image processing
d) Image reconstruction
    a. Forward problem
    b. Inverse problem
        i. Back projection
        ii. Iterative method
e) Image registration/fusion

2) Wave Metrology

a) Components of wave metrology systems
i) Radiation Input
ii) Interaction/transformation
iii) Imaging system
iv) Detection

3) Applications

a) Microscopy

(1) Basic concepts

i. Types of microscopy

- Bright field, Phase contrast
- Fluorescence
- Confocal
- Non-linear
  - Multiphoton, Harmonic generation, Raman
- Super resolution
  - SIM, STED, PALM/STORM
- Light-sheet
- Photoacoustic
  - *Optical and acoustic resolution*

b) Macroscopic imaging

- Optical projection tomography (OPT)
- Optical coherence tomography (OCT)
- Diffuse fluorescence
- Bioluminescence
- Photoacoustic tomography
- Image guided surgery

c) Ultrasound

d) X-Ray Computed Tomography (X-Ray CT)

e) MRI

f) Nuclear imaging

(4) TEACHING and LEARNING METHODS - EVALUATION

Delivery *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of slides • Videos with demonstration/understanding experiments. • Use of Demonstration experiments • Use of an asynchronous e-learning platform (e-class) where the following are provided: o *Bibliography of the course* *o Slides of the course* *o Solved and unsolved exercises* *o Self-study Exercise Set* *o Demonstration videos and simulations* *o* Communication through the e-class platform, use of the discussion area facility with topics, email as well as fixed office hours announced

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<tr><td></td><td>• Students' assignments are received and corrected via the platform (e-class)</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>Assignments/Projects</td><td>50</td></tr>
<tr><td>Directed learning activity (office hours)</td><td>26</td></tr>
<tr><td>Non-directed learning activity</td><td>35</td></tr>
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<tr><td>Course total</td><td>150</td></tr>
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<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>Language of Evaluation: English

The final grade is the sum of
30% of the grade of a written report and public presentation for an assignment
70% of the grade of the final written examination</td></tr>
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(5) ATTACHED BIBLIOGRAPHY

Bibliography

- *Lecture notes*
- *Lecture slides with explanatory text*
- *" Introduction to Biomedical Imaging, 2nd Edition ", by A. Webb, Wiley-IEEE Press, (2022)*
- *“Essentials of In Vivo Biomedical Imaging”, by S. R. Cherry, R. D. Badawi, J. Qi, CRC Press, (2015)*

- *"Introductory Biomedical Imaging: Principles and Practice from Microscopy to MRI", by B. A. Scalettar, J. R. Abney, CRC Press (2023)*