Syllabus

Course Description

Course Title	Flexible Electronics: From Materials to Systems and Applications
Course Code	46060
Course Title Additional	
Scientific-Disciplinary Sector	IINF-01/A
Language	English
Degree Course	PhD Programme in Advanced-Systems Engineering
Other Degree Courses (Loaned)	
Lecturers	Dr. Zina Fredj Ep Tej, Zina.FredjEpTej@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/52392
Teaching Assistant	
Semester	Second semester
Course Year/s	1
CP	3
Teaching Hours	30
Lab Hours	0
Individual Study Hours	15
Planned Office Hours	
Contents Summary	The course is a specialized course in the interdisciplinary area of physics, material science, chemistry, biology, biotechnology, and electronics, addressing the implementation of flexible electronics technologies. It is designed to acquire knowledge in flexible electronics device technology, from materials and fabrication processes, to devices, systems, and applications, including state of the art and the status of commercialization.
Course Topics	1. Flexible electronics: general introduction - Historical background - Materials, devices, systems, applications

	- Fabrication techniques - Unique aspects, status in the field and trends 2. Thin-film microfabrication techniques - Basics and fundamentals - Deposition and structuring methods 3. Printing techniques - Basics and fundamentals - Fluid formation and rheology for printing - Inks and printing techniques - Additional coating and structuring methods 4. Thin-film transistors and circuits - Thin film transistors (TFTs) - Device operation, materials, and structures - Device characterization and performance - UNIBZ's case study: sub-micrometer Indium-Gallium-Zinc-Oxide TFTs and spray-coated carbon nanotube TFT - Thin film circuits - From transistors to circuits - Digital and analog circuits 5. From thin-film transistors to biosensors - Transistors-based sensors - Principles and fundamentals - Examples - Unibz's case study: electrolyte-gated field effect transistors and organic electrochemical transistors 6. Applications - Examples applications from academia and industry
Keywords	Flexible electronics; printed electronics; stretchable electronics; organic electronics; functional materials; flexible substrates; conductive polymers; nanomaterials; thin films; fabrication techniques; additive manufacturing; device integration; flexible sensors; wearable devices; electronic skin; energy harvesting; biomedical applications; commercialization.

Recommended Prerequisites	
Propaedeutic Courses	
Teaching Format	Digital format (provided on teams) divided in: - Theoretical lectures using: - Slides - Videos - Practical exercises: - Use of softwares (e.g., Origin, Corel) for data analysis and plotting. - Projects & assignments: - Informal discussions on presentations and scientific papers - Preparation of short papers based on literature review
Mandatory Attendance	Preferred
Specific Educational Objectives and Learning Outcomes	The specific educational objectives are to: - Acquire basic understanding and knowledge of printing and microfabrication technologies. - Acquire basic understanding and knowledge of device operation mechanisms (especially for what concerns thin-film transistors and transistor-based sensors).
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	A project work developed by the student will be assessed: presentation and discussion of a topic related to the contents of the course agreed between lecturer and students.
Evaluation Criteria	Quality of the presentation and engagement in the practical project.
Required Readings	assigned in class
Supplementary Readings	Bibliography: • "Organic Flexible Electronics: Fundamentals, Devices, and Applications", P. Coseddu and M. Caironi, Elsevier, 2020. • "Organic and Amorphous-Metal-Oxide Flexible Analogue Electronics", V. Pecunia, M. Fattori, S. Abdinia, H. Sirringhaus, and E. Cantatore, Cambridge Elements, 2018. • "Organic and Printed Electronics: Fundamentals and Applications", G. Nisato, D. Lupo, S. Ganz, CRC Press,

	2016. • “Large Area and Flexible Electronics”, M. Caironi and Y.Y. Noh, WILEY-VCH, 2015. • “Flexible Electronics: Materials and Applications”, W. S. Wong, A. Salleo, Springer, 2009.
Further Information	
Sustainable Development Goals (SDGs)	Quality education