Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Flexible Electronics: From Materials to Systems and Applications
Course code	46060
Scientific sector	ING-INF/01
Degree	PhD in Advanced Systems Engineering
Semester	2
Year	1
Academic year	2024/2025
Credits	3
Modular	No

Total lecturing hours	30
Attendance	Preferred
Prerequisites	None
Course page	None

Specific educational objectives	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. 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).

Lecturer	Luisa Petti
Scientific sector of the lecturer	ING-INF/01
Teaching language	English
Office hours	From Monday to Friday, on appointment
List of topics covered	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. <u>Printing techniques</u>
	- Basics and fundamentals
	- Fluid formation and rheology for printing
	- Inks and printing techniques
	- Additional coating and structuring methods
	
	4. <u>Thin-film transistors and circuits</u>
	- 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 TFTs
	- Thin film circuits
	  - From transistors to circuits
	  - Digital and analog circuits
	
	5. <u>From thin-film transistors to biosensors</u>
	- Transistors-based sensors
	  - Principles and fundamentals
	  - Examples
	  - Unibz's case study: electrolyte-gated field effect transistors and organic electrochemical transistors
	
	6. <u>Applications</u>
	- Examples applications from academia and industry

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

Learning outcomes	**Knowledge and understanding**: theoretical know-how on printing, microfabrication, and characterization technologies for electronic components. **Applying knowledge and understanding**: practical know-how on printing, microfabrication, and characterization technologies for electronic components. **Making judgments**: Capability of identifying the most suitable fabrication and characterization methods to realize specific electronic devices for a given targeted application. **Communication skills**: ability to give a specialized technical presentation supported by power-point slides. **Learning skills**: performing a literature review on a given topic; extracting the most valuable information and embedding it in a presentation.

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.
Assessment language	English
Evaluation criteria and criteria for awarding marks	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.