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Modernization of curriculum of Textile Engineering and Textile Technology in Indonesia, Malaysia and Pakistan

SMARTEX

WP 1 Deliverable 1.2

Context report for internship programmes

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[Context report for internship programs - WP 1 Deliverable 1.2]

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Abbreviations and Acronyms

EC	European Commission
EU	European Union
GA	Grant Agreement
HAHE	Hellenic Authority for Higher Education
HEI	Higher Education Institution
ICT	Information and Communication Technologies
IHU	International Hellenic University
PC	Project Coordinator
UNIWA	University of West Attica
UGENT	Ghent University
UPV	Technical University of Valencia

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INTRODUCTION

The present report, named Benchmarking report on bachelor level course related to textiles between EU and Asia Universities, constitutes the second deliverable of the SMARTEX project.

This project will be accomplished by the joint work of 10 European and Asian partners with the aim of the modernisation of curriculum of Textile Engineering and Textile Technology in Indonesia, Malaysia and Pakistan. The expertise acquired from European partners is crucial for development of the curriculum of Textile Engineering and Textile Technology studies at bachelor level for universities in Pakistan, Malaysia and Indonesia, training their staff and ensuring their efficiency and their role as engines of innovation and technology transfer in the Asian textile sector.

The report is part of the first phase of the project, which is the preparation phase constituting Work Package 1 (WP1).

This report has been structured around 2 main chapters. The first one includes an analysis of the state of the art of Higher Education curriculums related to smart and technical textiles in the three European countries. The second chapter includes recommendations relatively to bachelor and master studies, which will be transferred to Asian Universities.

The leader of this task was University of West Attica, which developed the framework of the study, its objectives, scope, research questions, methodology and tools. The methodology was desk research and interviews with stakeholders. The other European partners involved were University of Gent (Belgium) and Technical University of Valencia (Spain).

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[Context report for internship programs - WP 1 Deliverable 1.2]

Analysis of the state of the art of European Higher Education curriculums

1. Introduction – GREECE

In this work, an analysis of the textile-oriented study plans available in Greece will be carried out, focusing particularly on the subjects of advanced materials and Smart Textiles. These training plans are intended to prepare the professionals that will drive the textile sector of the future. The global demand for new specialized textile products in various sectors such as sports, medical, industrial, construction, automotive, aerospace, dictates the need for new types of textile professionals and experts capable to maximize the efficiency and versatility of the textile manufacturing. At the same time, the development of a new generation of professionals with high awareness regarding global sustainability is a major priority. The proper combination of multidisciplinary knowledge and skills will guide the textile sector in the production of new high-tech products and in a sustainable technological and economic growth. Universities around the globe enrich continuously their textile-oriented curricula in order to meet these requirements and face effectively the challenges of the future.

Currently, two Higher Education Institutions (Universities) offer textile-oriented studies in Greece: (1) The "University of West Attica", department of Industrial Design and Production and (2) The "International Hellenic University (IHU)", department of Creative Design and Clothing. Each of them offers a Bachelor degree program. Both are analysed in next paragraphs.

Starting from the next academic year, the "University of West Attica, department of Industrial Design and Production Engineering" will participate in an international collaborative Master degree program *(Textile Engineering Advanced Master 'WE-TEAM')*.

2. Textile Bachelor's studies

2.1 University of West Attica, Industrial Design and Production Engineering

The University of West Attica was founded in 2018 through the process of merging the Technological Educational Institute of Athens and the Piraeus University of Technological Sector. In 2019, the National School of Public Health joined the newly established University.

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The University of West Attica consists of a total of twenty-seven (27) departments, which operate under the academic umbrella of six (6) faculties, covering a wide range of scientific fields, such as social, administrative and economic sciences, engineering sciences, health sciences and arts studies.

According to official data, it is the third largest university institution in the country in terms of the number of enrolled undergraduate students, as it has about 55,700 students.
The School of Engineering of the University of West Attica offers a high level education through undergraduate, postgraduate and doctoral programs in the scientific fields of the following departments:

- Department of Electrical and Electronic Engineering
- Department of Biomedical Engineering
- Department of Industrial Design and Production Engineering
- Department of Informatics and Computer Engineering
- Department of Topographic Engineering and Geoinformatics
- Department of Mechanical Engineering
- Department of Shipbuilding Engineering
- Civil Engineering Department

The department of Industrial Design and Production Engineering founded as a new department of the University of West Attica, by merging the two previously existing departments of Textile Engineering and Automation Engineering of the Piraeus University of Technological Sector. The join of the two departments, with the first oriented to material and manufacturing technologies and the second oriented to automation technologies, aimed to the creation of a new profile of graduates with a higher level of interdisciplinary knowledge, capable to meet the challenges of the modern industry.

2.1.1 Basic Information

The subject of the Department of Industrial Design and Production Engineering is the design of modern systems and services by applying the optimum approaches in the interdisciplinary area of design, creatively combining knowledge and methodologies that derive from a wide range of sciences and emphasize on the use of new technologies for the design and production of innovative products.

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The purpose of the Department is to produce graduates who will be able to creatively employ new technologies, science and art in order to design solutions in the form of usable and operational Products, Procedures and Systems in all the productive sectors. The Department thereby meets both the current and emerging needs for industry and business executives in the global competition.

The Five-year Study Program of the Department of Industrial Design and Production Engineering of the University of West Attica was developed to provide the necessary knowledge, skills and abilities to practice as an Engineer in two fields:

1. Industrial Production

In the field of Industrial Production, the program offers the necessary background for the employment in research, design, study, construction and safe operation of any type of industrial facilities and devices. Many subjects use as reference the various processes and systems of the textile industry sector. In these subjects, the paradigm of the textile industry offers a basis for a comprehensive and multifaceted examination of the matters of industrial practice, e.g. from energy production to packaging, from the original design to the control of each manufacturing detail, from production planning to result monitoring and evaluation.

2. Administration and management

In the field of Administration and Management, the program covers the modern methods concerning collection and processing of information, assistance in business decision-making procedures, automation and control and surveillance of industrial production systems. The range of relevant subjects particularly focuses on digital methods and technologies. Thus, the problem of administration and management is addressed in a unified and comprehensive manner in different time and space scales, e.g. from the level of the industrial site and machine automation to the level of the internetworked production chain and the interconnected industrial units across the globe (global cluster) etc.

2.1.2 Learning Objectives

The program Programme of the Department of Industrial Design and Production Engineering of the University of West Attica has been drawn up taking into consideration the guidelines provided by the Hellenic Authority for Higher Education (HAHE) and aims at:

- the supply of high-quality tertiary education at both theoretical and laboratory level;
- the continuous adaptation of the educational subject to the new developments of science, research and technology;

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- the fostering of specialized abilities to combine sciences, technologies, methods, materials and properties in order to develop innovative products and services;
- the shaping of rational thinking and analysis to solve practical problems and apply the theoretical knowledge to the established and modern industrial methods;
- providing a solid and extensive scientific background for the purpose of mobility and flexibility in the modern competitive international environment, meeting the needs of the labor market;

Following the completion of studies, the graduate Industrial Design and Production Engineer possesses knowledge, abilities and skills that allow them to:

- to successfully respond to the competitive working environment with exceptional career prospects;
- to successfully pursue the Postgraduate Study Program at the higher-education institutions of Greece and abroad.

2.1.3 Structure of the Study Program

In order to support the knowledge of both fields (Industrial Production and Administration and Management), the program includes 94 subjects, 49 of which (48 instructed and Internship) is distributed in two Specialization Flows:

- Flow 1 “System Design” includes 26 compulsory-elective subjects in the seventh, eighth and ninth semester of studies. The subjects of Flow 1 emphasize on the systematic view of industrial activities and processes and the special role of digital media and methods therein.
- Flow 2 “Industrial Production” includes 22 compulsory-elective subjects in the seventh, eighth and ninth semester of studies. The subjects of Flow 2 focus on the effective setting up of industrial processes and deepening in production methods.

The two flows are supported by 45 compulsory subjects, 42 of which comprise the basic study cycle during the first three years of studies, and other three are included in the last two years of studies.

Particularly, the academic path to earn the title of the Industrial Design and Production Engineer includes the following:

- successful attendance of 42 compulsory subjects during the first three years of studies and additionally 3 compulsory subjects: one in the seventh, one in the eighth and one in the ninth semester;

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- successful attendance of 18 compulsory-elective subjects: six in the seventh, six the eighth and six in the ninth semester; and
- successful elaboration of thesis in the tenth semester.

** Optionally, one of the six subjects of the ninth semester may be substituted by a three-month internship.*

The successful completion of the Five-year Study Programme corresponds in total to 300 ECTS, distributed as follows:

- The subjects of the first three years (1st to 6th semester) correspond to 180 ECTS
- The subjects of the next three semesters (7th to 9th semester) correspond to 90 ECTS
- The elaboration of the thesis corresponds to 30 ECTS

2.1.4 Curriculum of the bachelor's degree in Industrial Design and Production Engineering

The overall curriculum is presented in the next table:

Bachelor in Industrial Design and Production Engineering

Semester 1		**ECTS**
101-	Mathematics I	5
102-	Physics I	4
103-	Introduction to Computer Science and Technology	4
104-	Technical Drawing	4
105-	Chemistry I	4
106-	Electrical Circuits	5
107-	Material Science and Technology	4
Semester 2		**ECTS**
201-	Mathematics II	5
202-	Physics II	5
203-	Algorithms and Data Structures	4
204-	Engineering Mechanics I	5
205-	Chemistry II	4
206-	Measurement Systems	4
207-	Design and Programming of Industrial Manufacturing Systems	4
Semester 3		**ECTS**
301-	Mathematics III	5

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302-	Probabilities - Statistics, Introduction to Stochastic Analysis	5
303-	CAD/CAM	4
304-	Engineering Mechanics II	4
305-	Materials I	4
306-	Electronic Systems	4
307-	Signals and Systems	4
Semester 4		**ECTS**
401-	Machine Elements	5
402-	Digital Systems	5
403-	Textile Industry	4
404-	Design and Programming of Supply Systems (Logistics)	5
405-	Data Acquisition Systems - Sensors	4
406-	Environmental Analysis and Design	4
407-	Design of Products & Services	4
408-	Seminar 1 (English Technical Terminology)	3
Semester 5		**ECTS**
501-	Thermodynamics and Heat Transfer	5
503-	Optimization Methods	4
504-	Manufacturing Technology I	4
505-	Computer Networks	4
506-	Automatic Control Systems I	4
507-	Ergonomics and Occupational Safety	4
508-	Electrical, Hydraulic & Pneumatic Control Systems	4
510-	Seminar 2 (English II)	3
Semester 6		**ECTS**
601-	Manufacturing Technology II	4
602-	Total Quality Management	4
603-	Decision Support Systems	4
604-	Materials II	4
605-	Fluid Mechanics	5
606-	Mechatronics	5
607-	Business Economics - Enterprenuership	4
Semester 7		**ECTS**
701-	Business Administration	6
	Specialization Flow 1: System Design	
711-	Energy Management Systems - Renewable Energy Sources	4

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712-	Microcontroller-based Systems Design	4
713-	Computer Numerical Control (CNC) Processes	4
714-	Additive Manufacturing Processes - 3D Printing	4
715-	Smart Grid - Power Electronics	4
716-	Digital Signal Processing	4
718-	Electromechanichal Installations Design	4
719-	Human-Machine Interaction	4
720-	Electric Drives	5
	Specialization Flow 2: Industrial Production	
721-	Physical Chemistry	4
722-	Environment - Management of By-products	4
723-	Garment Manufacturing Design	4
724-	Fiber Science	4
725-	Dyeing Processes I	4
726-	Computer Aided Engineering of Flexible Structure Products	4
727-	Advanced Materials	4
728-	Design of Linear Fibrous Structures Production	4

Semester 8		**ECTS**
801-	Artificial Intelligence	6
	Specialization Flow 1: System Design	
811-	Historical Evolution of Automation and New Technologies	4
812-	Automatic Control Systems II	4
813-	Nanoelectronics and Devices	4
814-	Industrial Web Applications	4
815-	Internet Of Things and Embedded Systems	4
816-	Autonomous Vehicles Design	4
817-	Art and Technology	4
818-	Transportation Systems Management	4
819-	Industrial Automation - PLC	4
	Specialization Flow 2: Industrial Production	
821-	Transport Phenomena	4
822-	Quality Control	4
823-	Composite Materials	4
824-	Flexible Structure Product Manufacturing	4
825-	Dyeing Processes II	4
826-	Manufacturing of 2D Fibrous Products	4
828-	Printing and Digital Printing	4

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830-	Smart Materials and Interactive Technologies	4
Semester 9		**ECTS**
901-	Marketing	6
	Specialization Flow 1: System Design	
911-	Intelligent Systems	4
912-	Digital Controller - Observer Design	4
913-	Dynamic Programming	4
914-	Machine Learning - Big Data Analytics	6
915-	Mobile Application Design	4
916-	Industrial Robotics Systems	5
917-	Non-Destructive Control and Systems diagnosis	4
918-	Cyber-Physical Systems	4
919-	Final Year Placement	30
	Specialization Flow 2: Industrial Production	
921-	Finishing and Interactive Products	4
923-	Decoloration and Bleaching Mechanisms	4
924-	3D Multilayer Structures	4
925-	Mechanics of Fibrous Structures Deformation - Advanced Quality Control	4
926-	Manufacturing of Specialized Products	4
930-	Design & Developement of Product Collection	4
919-	Final Year Placement	30
Semester 10		**ECTS**
100-	Dissertation	30

The basic courses are similar to other engineering departments, dealing with subjects like physics, mathematics, chemistry, technical design, industrial ICT and automation systems. This allows students to develop a solid engineering and multidisciplinary background, which is followed by the specialization in specific textile-oriented subjects.

Most textiles courses are offered as part of the optional route of “Industrial Production” in the last 3 years of the degree. This route offers specialization in a wide range of textile-engineering subjects.

The textile engineering specialization is formed by the next subjects:

403-	Textile Industry	4

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504-	Manufacturing Technology I	4
601-	Manufacturing Technology II	4
604-	Materials II	4
722-	Environment - Management of By-products	4
723-	Garment Manufacturing Design	4
724-	Fiber Science	4
725-	Dyeing Processes I	4
726-	Computer Aided Engineering of Flexible Structure Products	4
727-	Advanced Materials	4
728-	Design of Linear Fibrous Structures Production	4
822-	Quality Control	4
823-	Composite Materials	4
824-	Flexible Structure Product Manufacturing	4
825-	Dyeing Processes II	4
826-	Manufacturing of 2D Fibrous Products	4
828-	Printing and Digital Printing	4
830-	Smart Materials and Interactive Technologies	4
921-	Finishing and Interactive Products	4
923-	Decoloration and Bleaching Mechanisms	4
924-	3D Multilayer Structures	4
925-	Mechanics of Fibrous Structures Deformation - Advanced Quality Control	4
926-	Manufacturing of Specialized Products	4
930-	Design & Developement of Product Collection	4

Details of each subject are presented in the following tables:

COURSE TITLE	403 - TEXTILE INDUSTRY
LEARNING OUTCOMES	
The dynamic development of all branches of the Textile Industry, the modern methods of production and processing of textiles and clothing as well as their new uses are the subject of the Course. Upon completion of the course students will have: 1. Thorough knowledge and critical understanding of the structure of textiles which determines their special characteristics and properties which in turn influence and determine to a large extent the properties of the products produced by them.	

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2. Thorough knowledge and critical understanding of the production chain and the uses of textiles.

In detail, students will be able to:

1. Understand the importance of the properties of textiles raw materials and intermediates, which are necessary for the creation of quality finished products.
2. Understand and describe the basic principles of production methods and treatments used for the production of textiles and clothing, according to the required specifications, the desired properties and functionality.
3. Know the types of products produced from the various materials as well as basic information for the care of these products.
4. Understand the specific uses of certain technologically advanced textiles.

GENERAL COMPENTENCES

- Search, analysis and synthesis of data and information, using all necessary technologies: Study of needs of systems / sources of supply of fibrous materials, preparation of a feasibility study for the installation and utilization of these systems, i.e., design, development, installation, support and supervision operation of fibrous material supply systems / sources.
- Adaptation to new situations: Evaluation and improvement of the operation of the systems / sources of supply of fibrous materials.
- Decision making: Composition and harmonious operation of the machine components of the fibrous material supply systems / sources.
- Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
- Teamwork: Ability for dialogue, criticism, self-criticism and commitment to implement an agreement.
- Working in an international environment: communicative ability in international languages, respect for diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
- Work in an interdisciplinary environment: ability to understand problems and requirements for systems improvement and knowledge of solution methods.
- Generation of new research ideas: promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

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1. Historical development of the industry - The Global Textile Grid,
2. Raw Materials and Textiles,
3. Current state of production and consumption of raw materials and products,
4. Production Procedures for Raw Materials and Products,
5. Basic principles of quality control,
6. Traditional uses in clothing and everyday products,
7. Textiles and interdisciplinarity,
8. New uses in high technology products (*technical textiles, protection products, intelligent textiles*),
9. Product Life Cycle and environmental impact,
10. Ecotextiles: The path to the sustainable development of textiles,
11. Biodegradable raw materials and textiles,
12. The Global Organic Textile Standard (GOTS),
13. EU Ecolabel award for textiles and clothing.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face. Distance learning procedures for lecturing when required, e.g. due to COVID-19.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	
Fieldwork	13
Essay Writing	18
Study	60
Course total	**130**

STUDENT PERFORMANCE EVALUATION

Language of Evaluation: Greek

Methods of Evaluation:

- Written final exams 60% of overall grade.
- Mid-term exams and compulsory essay 40% of overall grade.

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COURSE TITLE	504 - MANUFACTURING TECHNOLOGY I

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the various types of solid material (flexible and non-flexible) and their physical-mechanical properties and characteristics.
2. In-depth knowledge and critical understanding of the various production line processes of the various solid materials.
3. Knowledge and skills in the various production systems and applied technologies.
4. Knowledge and skills in the technological aspects of conversion processes of various polymer materials into linear (pure and blended) solid products.
5. Knowledge and skills in the technological aspects of conversion processes of linear materials into 2-D (pure and blended) products.

Specifically, students will be able to:

1. To describe and identify the various solid material types and their physical-mechanical properties and characteristics.
2. To describe and identify the flow charts of processing both flexible and non-flexible solid materials.
3. To describe, identify and evaluate the performance of the flexible solid materials processing systems aiming at the simple calculations of the various factors including production rate, machinery and operator efficiency and product costing.
4. To implement certification and quality improvement techniques whenever it is required.
5. To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the necessities of flexible and non-flexible solid material processing systems, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the linear and 2-D products

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processing systems operation.
Adapting to new situations: evaluation and improvement of the operation of the linear and 2-D product processing systems.
Decision Making: Synthesis and proper operation of the machinery/processes of the linear and 2-D product processing systems.
Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement.
Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
Work in a multidisciplinary environment: Ability perception problems and needs of flexible materials processing systems and knowledge-solving methods.
Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

1. Distinctive technological characteristics and properties of the various solid material types.
2. Production line of the various solid material types and conversion processes of polymer materials into linear and 2-D (pure and blended) products.
3. Principles of establishment of new micro and small enterprises, material processing oriented. General principles of production organisation of such enterprises.
4. Quality assurance systems. Philosophy of Total Quality Management.
5. Application of Quick Response, Right First Time and Just in Time principles in micro and small enterprises.
6. Case studies on simple calculation of various production (processing) factors, including production rate, machinery and operator efficiency and product costing.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.

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TEACHING METHODS	

Activity	Semester Workload
Lectures	50
Laboratory practice	
Fieldwork	
Essay Writing	**35**
Study	**35**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Assignments: 40%

ATTACHED BIBLIOGRAPHY

1. G. Chryssolouris: Manufacturing Systems - Theory and Practice, Springer 2005
2. C. Brecher: Advances in Production Technology, Springer, 2015
3. C. Brecher, D. Ozdemir: Integrative Production Technology, Springer, 2017
4. RTD Richards, AB Sykes: Manual of Textile Technology, Textile Institute, 1994
5. PR Lord: Handbook of yarn production, The Textile Institute, 2003
6. VD Dudeja: Management of textile industry, Textile Trade Press, 1981
7. A. Brearly, JA Iredale: The Worsted Industry, WIRA, 1980
8. RL Flood: Beyond TQM, J. Wiley & Sons, 1993
9. MJ Fox: Quality Assurance Management, Chapman and Hall, 1993
10. F Price: Right First Time, Gower, 1994

COURSE TITLE	**601 - MANUFACTURING TECHNOLOGY II**

LEARNING OUTCOMES

Upon completion of the course, students will have:

6. In-depth knowledge and critical understanding of the various types of solid and liquid materials and their chemical properties and characteristics.
7. In-depth knowledge and critical understanding of the various production line processes of the various liquid materials.
8. Knowledge and skills in the various production systems and applied technologies.
9. Knowledge and skills in the technological aspects of conversion processes of various liquid materials into liquid and/or solid products.
10. Knowledge and skills in the technological aspects of dyeing and finishing processes of solid products.

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Specifically, students will be able to:

1. To describe and identify the various types of solid and liquid material and their chemical properties and characteristics.
2. To describe and identify the flow charts of processing liquid materials.
3. To describe, identify and evaluate the performance of the liquid materials processing systems.
4. To describe, identify and evaluate the performance of the solid/liquid materials processing systems aiming at the complicated and advanced calculations of the various factors including production rate, machinery and operator efficiency and product costing.
5. To implement certification and quality improvement techniques whenever it is required.
6. To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the necessities of liquid material processing systems, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the liquid products processing systems operation.
Adapting to new situations: evaluation and improvement of the operation of the liquid product processing systems.
Decision Making: Synthesis and proper operation of the machinery/processes of the liquid product processing systems.
Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement.
Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
Work in a multidisciplinary environment: Ability perception problems and needs of liquid materials processing systems and knowledge-solving methods.
Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

1. Distinctive technological characteristics and chemical properties of the various solid/liquid material types.
2. Production line and processes of the various liquid material types.

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3. Dyeing and finishing processes of the various types of solid (flexible and non-flexible) materials.
4. Principles of establishment of new micro and small enterprises, chemical/liquid/dyestuff processing oriented. General principles of production organisation of such enterprises.
5. Quality assurance systems in such enterprises.
6. Case studies on advanced calculation of various production (processing) factors, including production rate, machinery and operator efficiency and product costing.

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	**50**
Laboratory practice	
Fieldwork	
Essay Writing	**35**
Study	**35**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Assignments: 40%

ATTACHED BIBLIOGRAPHY

1. G. Chryssolouris: Manufacturing Systems - Theory and Practice, Springer 2005
2. C. Brecher: Advances in Production Technology, Springer, 2015
3. C. Brecher, D. Ozdemir: Integrative Production Technology, Springer, 2017
4. VD Dudeja: Management of textile industry, Textile Trade Press, 1981
5. RL Flood: Beyond TQM, J. Wiley & Sons, 1993
6. MJ Fox: Quality Assurance Management, Chapman and Hall, 1993
7. SMBurkinshaw: Physico-chemical Aspects of Textile Coloration, SDC, 2016
8. JN Chakraborty: Fundaments and Practices in Colouration of Textiles, Woodhead, 2009
9. K Hunger: Industrial Dyes, Wiley, 2003
10. S Yang, W Li: Surface Finishing Theory and New Technology, Springer, 2018

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COURSE TITLE	604 - MATERIALS II

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theory of synthetic macromolecules, their synthesis and characterization, the rules of polymerization, the principles of polymer science, the treatments for polymer processing.
2. Apply procedures and control of fiber production, analyze structures, processes and techniques of polymer optimization and quality assurance.
3. Develop and evaluate molecular characterization and identification techniques, maintenance and adjustment of processing equipment, specifications of polymer uses and properties.

Specifically, students will be able to:

1. Describe and identify the polymer processing methods, recognize the synthetic textile fibers, select the technique for molecular weight determination.
2. Explain the general characteristics of polymers, assess their utility.
3. Compute the basic parameters of macromolecular structure, examine the dyeing applications of textile polymers.
4. Combine traditional natural polymer fibers and modern textile synthetic polymers, design products with improved features, develop techniques of filling, plasticizing and coating.
5. Compose new fabrics from polymer fibers, organize the manufacturing of products made from synthetic polymers.
6. Compare different synthetic fibers, evaluate the performance of their yarns.
7. Know and apply directives and regulations for environmental protection.

GENERAL COMPENTENCES

1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management.
2. Adapting to new situations.
3. Decision making, ability to criticism and self-criticism.
4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment.
5. Production of new research ideas and free, creative, inductive thinking.

SYLLABUS

Introduction and basic concepts of polymer chemistry. Nomenclature and Classification of polymers. Homopolymers and copolymers. Natural polymers (cellulose and keratin). Synthetic polymers (polyamides, polyacrylonitriles, polyesters). Structure and microstructure. Size, shape. Average molecular weights of polymers. Basic polymerization reactions. Linear polymers. Polymer processing methods, fiber production. Synthesis, structure, morphology, stereochemistry, properties, spinning and dyeing of textile polymers. Step-growth polymerization. Radical, anionic, cationic polymerization. Synthesis, yarn production, molecular characterization, morphology, properties of polymers with defined molecular weight and molecular weights distribution. Molecular weights determination by size exclusion chromatography (SEC), viscosity measurements

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in solution, membrane osmometry (MO), light scattering. UV–Visible, Infrared and Nuclear Magnetic Resonance spectroscopies for textile fiber recognition. Differential Scanning Calorimetry (DSC). Melting, glass transition temperature, crystallinity and mechanical properties of fibers. Fillers, plasticizers. Polymeric coatings.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

J. M. G. Cowie, "*Polymers: Chemistry and Physics of Modern Materials*", 2nd Edition, Blackie Academic and Professional, 1994.
H.-G. Elias, "*An Introduction to Plastics*", 1st Edition, VCH, 1993.
G. Challa, "*Polymer Chemistry: An Introduction*", 1st Edition, Ellis Horwood Ltd, 1993.
D. W. Van Krevelen, "*Properties of Polymers*", 3rd Edition, Elsevier, 1990.
V. B. F. Mathot, Ed., "*Calorimetry and Thermal Analysis of Polymers*", 1st Edition, Hanser Publishers, 1994.
M. Ward, D. W. Hadley, "*An Introduction to the Mechanical Properties of Solid Polymers*", 1st Edition, John Wiley and Sons, 1993.
R. A. Charvat, "*Coloring of Plastics: Fundamentals*", John Wiley and Sons, 2003.
R. M. Harris, "*Coloring Technology for Plastics*", William Andrew, 1999.
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R. B. Seymour, R. S. Porter, "*Man-Made Fibers: Their Origin and Development*", Elsevier Applied Science, 1993.
D. R. Salem, "*Structure Formation in Polymeric Fibers*", Hanser Verlag, 2001.
J. E. McIntyre, The Textile Institute, "*Synthetic Fibres: Nylon, Polyester, Acrylic, Polyolefin*", CRC Press, Manchester, 2005.
S. B. Warner, "*Fiber Science*", Prentice Hall, 1995.
V. B. Gupta, V. K. Kothari, "*Manufactured Fibre Technology*", Springer, 1997.
S. P. Mishra, "*A Textbook of Fibre Science and Technology*", New Age International, 2000.
K. K. Chawla, "*Fibrous Materials*", Cambridge University Press, 1998.
P. Ghosh, "*Fibre Science and Technology*", Tata McGraw-Hill Education, 2004.
L. H. Sperling, "*Introduction to Physical Polymer Science*", 2nd Edition, John Wiley and Sons, 1992.
U. W. Gedde, "*Polymer Physics*", 3rd Edition, Kluwer Academic Publishers, 1999.
Professors' notes

COURSE TITLE	722 - ENVIRONMENT – MANAGEMENT OF BYPRODUCTS

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theory of chemical, biological and mechanical processing, the laws of energy saving, the principles of pollution minimization, the treatments of textile effluents.
2. Apply procedures and control of waste treatment, analyze structures, processes and techniques of optimization and environmental protection.
3. Develop and evaluate management of byproducts, maintenance and adjustment of equipment, methods and specifications of waste processing.

Specifically, students will be able to:

1. Describe and identify methods of environmental protection, select the terms of environmental problem.
2. Explain the function of equipment, assess the waste composition of a dyeing plant.
3. Compute the determination parameters of pollution load, examine the basic quantities of wastewater characterization.
4. Combine modern and traditional treatments, plan improvements in processes, develop effective techniques and discriminate between different types of processes.
5. Compose new optimization strategies, organize waste minimization techniques, pretreatment and aftertreatment stages.
6. Compare different methods, evaluate their performance, support recycling of liquid and gaseous wastes.

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7. Know and apply directives and regulations for environmental protection.

GENERAL COMPENTENCES

1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management.
2. Adapting to new situations.
3. Decision making, ability to criticism and self-criticism.
4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment.
5. Production of new research ideas and free, creative, inductive thinking.

SYLLABUS

Energy as an economic quantity. Methods of performance optimization. Technologies of energy saving in key production stages and, mainly, in dyeing, drying and finishing. Dyehouse mechanical equipment and automation. Methods of productivity optimization for blends dyeing. Waste minimization techniques. Waste composition of dyeing and finishing plants. Chemical, biological and mechanical processing methods. Wastewater characterization parameters. Measurement of the pollution load in sewage. Determination of basic parameters, pH, residual chlorine, conductivity, BOD5, BOD21, TC, TOD, COD. Aerobic and anaerobic biological treatment. Pretreatment and treatment stages. Grease traps, sand collectors, grates, fine sieves, supply and homogenization tanks, precipitation, flotation, flocculation, aggregation, chemical oxidation, neutralization, activated sludge tanks, biological refineries, anaerobic digestion systems. Treatment of textile effluents. Liquid and gaseous waste recycling methods. Pollution of lakes and streams (torrents, rivers). Environmental problem formulation.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60%

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	• Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

R. M. Christie, “Environmental Aspects of Textile Dyeing”, CRC Press, 2007.
M. Miraftab, A. R. Horrocks, “Ecotextiles: The Way Forward for Sustainable Development in Textiles”, Woodhead Publishing Ltd, 2007.
K. Slater, The Textile Institute, “Environmental Impact of Textiles: Production, Processes and Protection”, Woodhead Publishing Ltd, Manchester, 2003.
K. Lacasse, W. Baumann, “Textile Chemicals: Environmental Data and Facts”, Springer, 2004.
Y. Wang, “Recycling in Textiles”, Woodhead Publishing Ltd/The Textile Institute, 2006.
E. Kabir, “Treatment of Textile Wastewater by Sulfonation Method”, VDM Verlag, 2010.
F. J. Cervantes, S. G. Pavlostathis, A. C. van Haandel, “Advanced Biological Treatment Processes for Industrial Wastewaters”, IWA Publishing, 2006.
P. N. L. Lens, L. H. Pol, P. Wilderer, T. Asano, “Water Recycling and Resource Recovery in Industry: Analysis, Technologies and Implementation”, IWA Publishing, 2002.

COURSE TITLE	723 – GARMENT MANUFACTURING DESIGN

LEARNING OUTCOMES

Upon completion of the course students will have:
1. Abilities to organize clothing production.
2. Capabilities of managing systems of an industrial unit for the production of garments.
3. Ability to understand the various problems that arise during garments production.

In detail, students will be able to:
1. Know the basic principles of clothing design.
2. To know the different stages of garment production (production line).
3. Understand the mechanisms and systems used for clothing production.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies. Problem management, Decision making, Team working and Working in an international environment

SYLLABUS

Historical background of the clothing industry in Greece. The structure of the ready-made clothing industry. Pattern design. Garments analysis, measurements and manufacturing. Types of seams, sewing machines and analysis of their use. Quality parameters of and finishing of ready-made garment.

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Packaging, storage and transport of ready-made garments. Total quality management systems. Quality certification procedures. Linear and non-linear cost ratios. Design by means of CAD/CAM systems.

Production planning in individual products. Customer based production planning. Batch production planning. Scheduling on Production Lines. Continuous Flow Systems. Production Planning software systems. Customer specifications management. Material requirement management. Analysis of clothing specifications. Sources of quality standards and legislation for clothing products (composition, care and flammability regulations). Evaluation of dyeing and printing failures on clothes. Overall assessment of the quality of the clothes. Management of the international clothing supply chain. Distribution strategies in clothing. Use of ICT in the clothing supply chain. Consumer Service (Efficient Consumer Response - ECR), Collaborative Planning, Forecasting and Replenishment (CFPR), Continuous Replenishment Model (CRM), Vendor-Managed Inventory (VMI). Stock types, Economic Order Quantity (EOQ), push / pull systems, procurement and outsourcing in clothing.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face, practice in laboratory, essays
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	70
Laboratory practice	15
Fieldwork	
Essay Writing	10
Study	15
Course total	**110**

STUDENT PERFORMANCE EVALUATION

Language of Evaluation: Greek

Methods of Evaluation:

- Written Examination: 60%
- Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

1. W. Aldrich, "Design and Cutting of Women's Clothing", 2009.
2. K. McKelvey, "Fashion Research - 1600 Ideas", 2005.
3. B. Wirschun, "Electronic Clothing Design with CorelDraw", 2009.

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4. H. Eberle, H. Hermeling, M. Hornberger, "Fachwissen Bekleidung", Europa-Lehrmittel, 2007.
5. A. Fontaine, "Technology for Bekleidungsberufe, Lehrbuch: Grundstufe und Fachstufen Lehr- / Fachbuch ", Stam, 2008.
6. C. Vindersvon, "Entwicklung eines Studiengangkonzeptes: Lehramt an Berufskollegs im Fach Bekleidungstechnik ", Akademikerverlag, 2011.
7. S. J. Jones, "Fashion Design (Portfolio)", 2011.
8. J. Sissons, "Basics Fashion Design: Knitwear", 2010.
9. G. Cho, "Smart Clothing: Technology and Applications", Taylor and Francis, 2009.
10. Helen Joseph Armstrong, Pattern Making for Fashion Design, 2015
11. The Fashion Book, by Editor of Phaodon, 2013
12. Clive Hallet, Fabric for Fashion, 2014
13. V.R. Babu, "Industrial engineering in apparel production", 2012.
14. C. Fairhurst, "Advances in apparel production", 2008.
15. G. Colovic, "Management of Technology Systems in Garment Industry", 2011.

COURSE TITLE	724 - FIBRE SCIENCE

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. Thorough knowledge and critical understanding of the structure of textile fibers which determines their specific characteristics and properties which in turn greatly influence and determine the properties of the products produced by them, both linear and two-dimensional structures.
2. Thorough knowledge and critical understanding of the most important physical and mechanical properties and characteristics of natural and man-made fibers (natural and synthetic polymer) as well as familiarity with the methods of their determination and measurement.
3. Knowledge and skills for the recognition of natural and man-made fibers.
4. Knowledge and skills for selecting and combining suitable fibers for the production of innovative products for specialized uses.

Upon completion of the course students will be able to:

1. To know from which plants and from which animals are collected fibres for textile use.
2. To recognize and evaluate the products produced from various plant fibres, animal hair as well as man-made fibers.
3. To specify the products produced from the textile fibers and to compose instructions for their care.
4. To design and evaluate methods for the production of man-made fibers from natural but also synthetic polymers.

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5. To formulate solutions for the production of products of special uses and high requirements by combining fibers of special characteristics and properties.
6. To apply methods for the identification of natural and artificial fibers.

GENERAL COMPENTENCES

Ability to search, analyze and synthesize data and information, using all necessary internet technologies and bibliographic research and networking: study needs of the systems / sources of supply of fibrous materials, preparation of a feasibility study for the installation and utilization of these systems, i.e. design, development, installation, support and supervision of the operation of supply systems / sources fibrous materials.

- Ability to make decisions, through solution processing and through processing options for doing the opposite tasks and exercises: selection, composition and harmonious operation of the machine components of the supply systems / sources fibrous materials.
- Ability to work independently, through the preparation of individually performed tasks and exercises: knowledge of regulations, protocols and ethical issues when developing innovation.
- Ability for group work, through the elaboration of group work and exercises: ability to dialogue, critique, self-criticism and commitment to implement an agreement.
- Ability to plan, manage and evaluate projects, through undertaking and elaboration completed work (project).
- Adaptation to new situations: evaluation and improvement of their operation systems / sources of supply of fibrous materials.
- Work in an interdisciplinary environment: ability to perceive problems and needs for improvement of systems / sources of supply of fibrous materials and knowledge of methods solving them.
- Production of new research ideas: promotion of free, creative and inductive thinking for the development of new strategic approaches.

SYLLABUS

1. Introduction to textile fibers.
2. General characteristics. Nature and structure of fibers.
3. Classification of fibers (natural, artificial).
4. Trends in the production and consumption of textile fibers.
5. Detailed presentation of fibers of each category (cellulosic, protein, man -made fibers of natural polymers, synthetic), with emphasis on the development and morphology of natural fibers and the production of artificial fibers.
6. Methods and devices for identification of textile fibers.
7. Physical, mechanical, chemical properties and characteristics of natural textile fibers.
8. Methods and apparatus for determining these physicochemical and mechanical properties.
9. Uses and conditions of proper fibre mixing for the production of specific products.

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10. Effect of properties and characteristics of fibers on finished products.
11. Laboratory exercises for the identification of textile fibers and for the determination of their physical, mechanical and chemical properties and characteristics (length, fineness, diameter, morphology, linear density, hygroscopicity, tensile strength).

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face. Distance learning procedures for lecturing when required, e.g. due to COVID-19.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	13
Project	20
Essay Writing/Presentation	20
Study	28
Course total	**120**

STUDENT PERFORMANCE EVALUATION

Language of Evaluation: Greek - English

Methods of Evaluation:

- Written final exams 60% of overall grade.
- Mid-term exams, Project and compulsory essay 40% of overall grade.

ATTACHED BIBLIOGRAPHY

1. J. W. S. Hearle, R. H. Peters, “Fibre Structure”, Butterworths, Manchester, 1963.
2. “Identification of Textile Materials”, The Textile Institute, Manchester, 1985.
3. J. E. Booth, “Principles of Textile Testing”, Heywood, London, 1986.
4. J. G. Cook, “Handbook of Textile Fibres”, I, II, Merrow, 1993.
5. S. B. Warner, “Fiber Science”, Prentice Hall, 1995.
6. J. C. Masson, “Acrylic Fiber Technology and Applications”, Marcel Dekker, Inc., 1995.
7. P. Carty, “Fibre Properties”, Pentaxion Ltd, Newcastle, 1996.
8. W. E. Morton, J. W. S. Hearle, “Physical Properties of Textile Fibres”, The Textile Institute, Manchester, 1997.
9. T. Hongu, G. O. Phillips, “New Fibers”, Woodhead Publishing Ltd, 1997.
10. B. P. Saville, “Physical Testing of Textiles”, Woodhead Publishing Ltd, 1999.
11. C. Woodings, “Regenerated Cellulose Fibres”, Woodhead Publishing Ltd, 2001.
12. J. Mussig, “Industrial Applications of Natural Fibres”, Wiley, 2010.

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13. J. W.S. Hearle, "High-performance fibres", Woodhead, 2001.
14. Laboratory Exercises – Professor's Notes

COURSE TITLE	725 - DYEING PROCESSES I

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the laws of radiation, the theory of color and novel materials, the principles of dyeing treatments, processes and machinery, the properties of advanced textile fibers.
2. Apply procedures and control of dyeing, analyze structures, processes and techniques for product optimization and dyeing quality assurance.
3. Develop and evaluate the manufacturing of colored products, maintenance and adjustment of dyeing equipment, methods and specifications of dyeing.

Specifically, students will be able to:

1. Describe and identify the methods, select the structures and equipment of dyeing.
2. Explain the function of dyeing machines, assess the capabilities of devices, materials and fiber components.
3. Compute the parameters of equipment operation, examine the applications of advanced fibers.
4. Combine modern and traditional dyeing processes, plan improvements in production, develop dyeing techniques and discriminate between different types of processes.
5. Compose new strategies of dye application, organize production and dyeing procedures.
6. Compare materials, colorations, products and processes, evaluate performance and efficiency of dyeing.
7. Know and apply directives and regulations for environmental protection

GENERAL COMPENTENCES

1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management.
2. Adapting to new situations.
3. Decision making, ability to criticism and self-criticism.
4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment.
5. Production of new research ideas and free, creative, inductive thinking.

SYLLABUS

Radiation and color. Introduction to dyes. Water and aqueous solutions in Dyeing. Electrolytes and ionic equilibria. Color fastness. Theories of Dyeing. Continuous and discontinuous processes,

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pretreatments and conditions of dyeing. Dyeing methods of cotton, wool, and synthetic fibers. Dyeing characteristics of various dye classes. Fundamentals of blend dyeing. Dyeing procedures and identification of textile substances. Physical, chemical and spectroscopic methods of textile identification. Physicochemical processes of dye application. Operation principles and classification of dyeing machines – Advantages and Limitations. Basic principles and preparations of printing. Fundamentals of Finishing. Mechanical and chemical Finishing processes.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

1. J. Shore, "*Cellulosics Dyeing*", The Society of Dyers and Colourists, 1995.
2. A. D. Broadbent, "*Basic Principles of Textile Coloration*", 2001.
3. A. K. R. Choudhury, "*Textile Preparation and Dyeing*", Science Publishers, 2006.
4. J. R. Aspland, "*Textile Dyeing and Coloration*", AATCC, 1997.
5. Hugh, MacDonald, Smith, "*High Performance Pigments*", Wiley-VCH, 2002.
6. G. Buxbaum, G. Pfaff, "*Industrial Inorganic Pigments*", Wiley-VCH, 2005.

COURSE TITLE	726 – DESIGN OF FLEXIBLE STRUCTURE PRODUCTS WITH CAD

LEARNING OUTCOMES

Upon successful completion of the course the student should:

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have developed skills in handling software applications and computer hardware devices, as well as the ability to present the knowledge gained from the lectures and the study material. Also to be able to pinpoint concepts related to topics, such as digital image differences between vector and digital, color models, electronic design of a specific concept. Finally, to handle electronic clothing design programs, creating clothing patterns, make conversions, corrections and sizing, presentation create electronic sketches and designs, manage collections, color charts and pattern files.

In detail, students will be able to:

- To design products of a flexible structure, such as fabric or garment on the PC
- Understand the basic principles of designing a fabric or garment in an electronic CAD design system and its application in industrial production.
- Evaluate the design after production and make corrections where required.
- Identify and solve production problems that are related with the design

GENERAL COMPENTENCES

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Troubleshooting
- Decision making
- Teamwork
- Work in an international environment

SYLLABUS

Theoretical part:

Introduction to desktop systems, graphic and design tools available to designers. Computers and the fashion industry. Rapid response technology. The concept of digital image (vector and digital) and color models. Systems under the term CAD and use of electronic systems for the design of textiles, clothing designs and presentation models. Design tools and computer design systems packages, including design capabilities for ready-made garments, prints and knitted fabrics. Pre-processing checks. Development and knitting of basic patterns in electronic knitting machines. Development of complex Jacquard designs on a computer and transfer in an electronic knitting machine. Combinations of loop designs and structures to reduce the cost of knitting and clothing. Effects of changing structures on the quality characteristics of knitwear. Development and manufacture of knitted "intarsia" of two, three and four colors. Development and construction of "intarsia" knits and knits with special appearances. Photorealism.

Laboratory part:

Familiarity with the software package environment. Basic design tools - vector design and processing. Coordinate systems, drawing scales. Design objects. Drawing tools, grouping of objects.

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Correction commands, property changes. Dimensions. Magnification commands, faces and slides. File management, prints. Fabric design. Creation of designs with electronic calculations. Design of checker board patterns and color knitted fabrics. Repeat of Patterns. Color prints scanning. Color separation. Reduce large number of colors to 7 colors. Development of color variations and multiple figures of a model, technical sketches, graphics and fabric samples. Trend study, trend color matching with printer, image scanning and digital image processing for creating models. Color Capture for creating a new color library. Editing and creation of instant access buttons for managing colors in a library. Creation of Color Charts.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face. Laboratory practice in teams.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	60
Laboratory practice	30
Educational visit in factory	15
Essay Writing	15
Study	20
Course total	**110**

STUDENT PERFORMANCE EVALUATION

Language of Evaluation: Greek

Methods of Evaluation:

- Written Examination: 60%
- Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

1. Wünsch, “Lexikon Wirkerei und Strickerei”, Deutscher Fachverlag, GmbH, 2008.
2. K. P. Weber, M. O. Weber “Wirkerei und Strickerei, Technologische und Bindungstechnische Grundlagen”, Melliand, 2008.
3. D. J. Spencer, “Knitting Technology: A Comprehensive Handbook and Practical Guide”, Woodhead Publishing Series in Textiles, 2001.
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5. E. Gravas, "Knitting Technology", Modern Publications, Athens, 2008.
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7. C. Iyer, B. Mammel, W. Schäch, “Rundstricken. Theory and Praxis der Maschentechnik ”, 1991.
8. K.-F. Au, “Advances in Knitting Technology”, Woodhead Publishing Series in Textiles, 2011.

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9. J. Wilson, Handbook of Textile Design: Principles, Processes, and Practice, 2001.
10. K. P. Weber, M. O. Weber "Wirkerei und Strickerei, Technologische und Bindungstechnische Grundlagen", Melliand, 2008.

COURSE TITLE	727 - ADVANCED MATERIALS

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theory of biopolymers, the laws of nanostructures and nanomaterials, the rules of Nanotechnology, the principles of nanofiber design and production, the electrospinning processing.
2. Apply procedures and control to estimate nanofiber properties, analyze structures, processes and techniques for Nanotechnology product optimization and quality assurance of biomaterials.
3. Develop and evaluate the technology of nanomaterials, maintenance and adjustment of electrospinning equipment, methods and specifications of biopolymer uses.
4. Specifically, students will be able to:
5. Describe and identify the methods of Nanotechnology, select the structures and equipment for biopolymer manufacture.
6. Explain the function of biopolymers in Tissue Engineering, assess the capabilities and uses of nanomaterials.
7. Compute the parameters of electrospinning, examine its applications.
8. Combine traditional textile structures and modern nanostructures, design improvements in biopolymer applications, develop fabric-protective products.
9. Compose structures from nanofibers, organize their production and incorporation in fabrics.
10. Compare various biomaterials, evaluate their performance and application.
11. Know and apply directives and regulations for environmental protection.

GENERAL COMPENTENCES

1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management.
2. Adapting to new situations.
3. Decision making, ability to criticism and self-criticism.
4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment.
5. Production of new research ideas and free, creative, inductive thinking.

SYLLABUS

Nanotechnology and advanced polymeric materials, nanomaterials, nanopolymers and nanofibers, biomaterials and biopolymers. Introduction, basic principles, classification, methods of production and modification of surfaces, general characteristics, structure, properties, uses, applications. Advanced synthetic fibers. Fully aromatic polyamides, p- and m- polyaramid fibers, their structure, production, properties and dyeing. Introduction to polymeric biomaterials: Biomimetic, bioinspired nanomaterials; composite and self-assembled biomaterials. Nanotechnology and nanofibers:

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Methods of nanofiber production; electrospinning. Factors influencing electrospinning. Material classes and their properties: Polymers, composite biopolymers, ceramics. Solution properties: Polymer solubility, viscosity, surface tension, vapour tension, conductivity. Design and types of nanofibers. Patterning of electrospinning apparatus and collectors. Polymers with antimicrobial properties. Applications: Chemical and biological fabric protection, filters, wound and burns therapy. Biopolymers and nanofibers in Tissue Engineering. Natural and synthetic materials, biocompatible materials and cell culture, protein development. Bioactive scaffolds: Structures, development, properties. Application in Tissue Engineering: Orthopaedic (bone, cartilage, dentistry), chirurgic (neural, arteries, skin, organs). Pharmaceutical biopolymers. Drug release applications. Characterization of advanced materials; Electron microscopy (TEM, SEM), Atomic Force Microscopy, Small Angle X-Ray Scattering, TGA. Work environment and advanced materials. Safety and dangers. Advanced materials. Human health and environment.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

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A. K. Haghi, A. K. Zachariah, N. Kalarikkal, "*Advances in Nanoscience and Nanotechnology*", 3, Apple Academic Press/CRC Press, Taylor and Francis Group (2013)
Professors' Notes

COURSE TITLE	728 - DESIGN OF LINEAR FIBROUS STRUCTURES PRODUCTION

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the short- and long- staple fibre conventional processes for the yarn production.
2. In-depth knowledge and critical understanding of the production of the continuous filaments as well as the conversion methods of the continuous filaments to staple fibres for the blended (mélange) yarn production.
3. Knowledge and skills in the elements and the proper settings of the various spinning machines of short and long staple fibres and continuous filaments.

Specifically, students will be able to:

1. To describe and identify the machinery used in both the conventional spinning systems (short-staple/cotton, long-staple/worsted) as well as the continuous filament production

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machinery and machinery for the conversion to short-staple fibres.
2. To explain the operation of every machine in both of the conventional spinning systems and to calculate their operating parameters.
3. To develop and specialise the applications of both conventional spinning systems, to compose and organise new applications and to evaluate the performance of each system.
4. To implement certification and quality improvement techniques whenever it is required.
5. To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the spinning systems' necessities, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the spinning systems operation.
Adapting to new situations: evaluation and improvement of the spinning systems' operation.
Decision Making: Synthesis and proper operation of the various machines/processes of the spinning systems.
Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement.
Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
Work in a multidisciplinary environment: Ability perception problems and needs for optimisation of spinning systems and knowledge-solving methods.
Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

1. Distinctive technological characteristics of short and long staple fibrous materials.
2. Principles of conventional yarn spinning system processes.
3. Conventional short-staple spinning technology (carded-combed processes, machinery, machine settings and characteristics).
4. Conventional long-staple spinning technology (woollen-worsted processes, machinery, machine settings and characteristics).
5. Yarn technical specifications/parameters for particular end-uses.
6. Blended yarn production elements.
7. Spinning technology of continuous filaments (processes, machinery).
8. Design of yarn production.
9. Problem solving of yarn production processing.

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10. Calculations concerning short-staple yarn production, machine efficiency and quality control characteristics of each yarn processing stage.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION

Language of Evaluation: Greek
Methods of Evaluation:

- Written examination: 60%
- Laboratory exercise: 40%

ATTACHED BIBLIOGRAPHY

1. W Klein: Manual of Textile Technology, Textile Institute, 1995
2. E Oxtoby: Spun Yarn Technology, Butterworths & Co. Ltd, 1987
3. RTD Richards & AB Sykes: Manual of Textile Technology, Textile Institute, 1994
4. JE Booth: Textile Mathematics Vol.1,2,3, The Textile Institute, 1975
5. PR Lord: Handbook of yarn production, The Textile Institute, 2003
6. A Brearly & JA Iredale: The Woolen Industry, WIRA, 1980
7. A Brearly & JA Iredale: The Worsted Industry, WIRA, 1980
8. H Lubos, P Ursiny: Yarn Texturizing Technology, COMETT EUROTEX, 1994

COURSE TITLE	**822 - QUALITY CONTROL**

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the theory and principles of quality control and statistics, especially on textiles
2. Knowledge and skills in the design of quality control systems in the textile industry
3. Knowledge and skills in the standardisation and optimisation of textile products.

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Specifically, students will be able to:

4. To describe and identify the various devices used in quality control of semi-processed and final products of the spinning mills (fibres, sliver, roving, yarns), weaving and knitting mills (woven and knitted fabrics and nonwoven) examining most of the physical, mechanical, optical, thermal, electrical and other properties and characteristics.
5. To explain the operation of every device used in a quality control laboratory for testing textile fibrous materials and final products.
6. To develop and specialise the applications of existent devices and methods used for the quality control of fibre, yarn and fabric manufacturing products, to compose, organise and evaluate the performance of new applications (devices and methods).
7. To implement certification and quality improvement techniques whenever it is required.
8. To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the quality systems' necessities, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the systems' operation concerning the quality and the quality control of textile fibrous assemblies (products).
Adapting to new situations: evaluation and improvement of the quality control systems' operation concerning the textile fibrous assemblies.
Decision Making: Synthesis and proper operation of the various systems for the quality control the textile products.
Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement.
Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
Work in a multidisciplinary environment: Ability perception problems and needs for optimisation of systems used in textile quality control and knowledge-solving methods.
Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

1. Quality, Quality management, Quality assurance and Quality control in modern industrialism and production conditions.
2. Laboratory organisation and quality control design in modern spinning mills.
3. Physical and mechanical properties and characteristics of yarns.
4. The effects of fibre properties on the quality of the produced yarns
5. Modern statistical method applications to quality control of spinning mill semi-processed products for identifying technical problems.
6. Quality control case studies.

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Exercises, problems and practicals for the quality determination of the products of various spinning, weaving and knitting processes as well the textile fibre-yarn-fabric properties: (linear density, twist, hygroscopicity, optical and capacitance assessment of unevenness, tensile strength, friction, hairiness, thickness, crease recovery, wrinkle recovery, radiation heat transfer, water and vapour permeability, pilling, abrasion resistance, bursting etc.).

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Laboratory exercise: 40%

ATTACHED BIBLIOGRAPHY

BP Saville: Physical testing of textiles, Woodhead, 1999
JE Booth: Principles of the Textile Testing, 1986
WE Morton & JWS Hearle: Physical properties of textile fibres, The Textile Institute, 1997
M Bona: Textile Quality, The Textile Institute, 1994
GAV Leaf: Practical statistics for the Textile Industry: Part I, The Textile Institute, 1984
GAV Leaf: Practical statistics for the Textile Industry: Part II, The Textile Institute, 1987
M Bona: Statistical methods for the textile industry, Eurotex – Comett, 1993
J Hu: Fabric Testing, Woodhead, 2008
L Wang: Performance testing of textiles, Woodhead, 2016
Textile ISO, EN, BS, ASTM standards

COURSE TITLE	823 - COMPOSITE MATERIALS

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

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1. Thoroughly know and comprehend the theory of composites, the laws of composite structures and materials, the rules of composite technology, the principles of composite design and production. 2. Apply procedures and control to estimate composite properties, analyze structures, processes and techniques for composite technology product optimization and quality assurance of composite materials. 3. Develop and evaluate the technology of composites, maintenance and adjustment of production equipment, methods and specifications of composite uses. Specifically, students will be able to: 1. Describe and identify the methods of composite technology, select the structures and equipment for composite manufacture. 2. Explain the function of composites in Engineering, assess the capabilities and uses of composite materials. 3. Compute the parameters of composite production, examine its applications. 4. Combine traditional textile structures and modern composite structures, design improvements in composite applications, develop fabric-protective products. 5. Compose structures from fibers, organize their production and incorporation in fabrics. 6. Compare various composite materials, evaluate their performance and application. 7. Know and apply directives and regulations for environmental protection.
GENERAL COMPENTENCES
1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management. 2. Adapting to new situations. 3. Decision making, ability to criticism and self-criticism. 4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment. 5. Production of new research ideas and free, creative, inductive thinking.
SYLLABUS
Composite materials. Textile fibers used for composite material fabrication. Production methods, properties, impact behavior, moisture absorption and advantages of composites. Fiber-reinforced polymers, matrices and resins. Composites for design and production of protective and antiballistic equipment. Multilayer composites, laminated and sandwich. Ceramic fibers, structure, production, characteristics and textile applications. Ceramic materials and fibers of special features.
TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.

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TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

J. W. S. Hearle, "*High Performance Fibers*", Woodhead Publishing Ltd, 2004.

T. Fukuda, Z. Maekawa, T. Fujii, "*Advances in Fiber Composite Materials*", Elsevier, 1994.

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B. D. Agarwal, L. J. Broutman, K. Chandrashekhara, "*Analysis and Performance of Fiber Composites*", John Wiley and Sons, 2006.

K. K. Chawla, "*Fibrous Materials*", Cambridge University Press, 1998.

COURSE TITLE	**824 - Flexible Structure Product Manufacturing**

LEARNING OUTCOMES

Upon completion of the course students will have:

1. Thorough knowledge and critical understanding of the processes for the production of woven and knitted fabrics, as well as related quality assurance aspects.
2. Thorough knowledge and critical understanding of the technologies of production of flexible structure products in conventional and non-conventional textile and knitting machines.

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3. Knowledge and skills of the elements and the required procedures of transformation of the theoretical design into fabric and vice versa.
4. Knowledge and skills of the elements and the required procedures for locating and solving problems related to technological, design and production parameters.

In detail, students will be able to:

1. Describe and identify the various designs and categories of fibrous flexible products (knitted and woven fabrics).
2. Understand the mechanisms of creating the structural elements of fabric architectures.
3. Describe and recognize the technological characteristics of the various innovative interventions in machines for the production of flexible products.
4. Understand the interaction between various mechanical elements, as well as between mechanisms and materials and be able to define the technological requirements for the production of specific flexible structure products.
5. Develop various setups for weaving and knitting manufacturing lines and make adjustments for increasing performance or making new products.
6. Apply certification and quality assurance systems whenever required.
7. Apply regulations and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Study of needs of weaving and knitting systems, preparation of a feasibility study for the installation and utilization of these systems, i.e. design, development, installation, support and supervision the operation of the relevant systems.

Adaptation to new situations: Evaluation and improvement of the operation of the relevant systems.

Decision Making: Composition and harmonious operation of the machinery components of the weaving and knitting preparation systems.

Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.

Teamwork: Ability for dialogue, criticism, self-criticism and commitment to implement an agreement.

Working in an international environment: Communication skills in international languages, respect for diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.

Work in an interdisciplinary environment: Ability to understand the problems and needs of improving weaving, weaving and knitting preparation systems and knowledge of methods to solve them.

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Generation of new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

1. Illustration and creation of flexible structure products (design of fabric structures).
2. Basic principles and specialized approaches to the formation of a structural element in weave-warp-knitted fibrous products.
3. Advanced design methods of knitted and woven fibrous products of flexible structure.
4. Innovative interventions in machines for the production of specialized knitted and crocheted machines.
5. Weaving preparation systems (conventional-non-conventional technologies, machines, basic settings and their characteristics).
6. Production systems of woven fibrous products of flexible structure (conventional-non-conventional technologies, machines, basic settings and their characteristics).
7. Optimization of quality and production of flexible construction products.
8. Exercises in the production process.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face. Distance learning procedures for lecturing when required, e.g. due to COVID-19.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	26
Laboratory practice	26
Essay Writing	13
Project assignment	26
Study	29
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

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1. Wünsch, “Lexikon Wirkerei und Strickerei”, Deutscher Fachverlag, GmbH, 2008.

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2. K. P. Weber, M. O. Weber "Wirkerei und Strickerei, Technologische und Bindungstechnische Grundlagen", Melliand, 2008.
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18. H. Hollstein, "Fertigungstechnik Weberei Mechanismen", II, Veb Fachbuchverlag, Leipzig,1980
19. H. Hollstein, "Fertigungstechnik Weberei Webmachinen", III, Veb Fachbuchverlag, Leipzig, 1985.
20. Online Bibliography Renewed Annually.
21. Laboratory Exercises - Teaching Notes

COURSE TITLE	825 - DYEING PROCESSES II

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theories of dyeing, the laws of dyeing kinetics, the manufacturing principles of dyeing machinery and the preparation of dyes.
2. Apply procedures and control of production, analyze structures, processes and techniques for optimization and quality assurance of dyeing.
3. Develop and evaluate chemical and spectrophotometric methods, maintenance and adjustment of dyeing and analytical equipment, patterns and specifications of dyeing.

4. Specifically, students will be able to:

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5. Describe and identify the spectroscopic techniques, select the structures and equipment. 6. Explain the physicochemical parameters of dyeing, assess the composition and quality of textiles. 7. Compute the factors of dyeing equipment operation, examine the application of analytical methods. 8. Combine dyeing processes and colorants, design dyeing-quality systems, develop manufacturing procedures. 9. Compose new management strategies, organize the quality control of dyeing. 10. Compare shades and quality characteristics of dyeing, evaluate the performance of quality control. 11. Know and apply directives and regulations for environmental protection
GENERAL COMPENTENCES
1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management. 2. Adapting to new situations. 3. Decision making, ability to criticism and self-criticism. 4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment. 5. Production of new research ideas and free, creative, inductive thinking.
SYLLABUS
Kinetics of dyeing. Dyeing with all types of dyes. Influence of temperature, stirring and chemical modification of fibers on dyeing kinetics. Dyeing of all textile classes with suitable types of dyes. Analysis of symbols illustrated in the pattern cards. Size of dye molecules, principles of dye combinativity, shade reproducibility, color fastness. Quantitative and qualitative blend analysis. Special calculations for correct operation of dyeing machines. Design of a modern dyehouse. Historical evolution of technology of colorants manufacture and use. Dyestuffs, chemical structure. Description of dye production technology. Dyeing auxiliaries chemical tests. Spectrophotometric tests in dye liquors. Applications of reflectance spectroscopy in color identification. Application of thin layer chromatography (T.L.C.) to coloring substances. Synthesis of dyes–pigments. Identification of dyes in substance and on the fiber. Determination of color fastness. Grayscale theory. Measurement of fastness to washing and rubbing. Hydrophobicity measurements on finished textiles.
TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.

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TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

C. M. Carr, “Chemistry of the Textiles Industry”, Springer, 1995.
K. Hunger, “Industrial Dyes: Chemistry, Properties, Applications”, John Wiley and Sons, 2003.
H. Zollinger, “Color Chemistry: Syntheses, Properties, and Applications of Organic Dyes and Pigments”, Helvetica Chimica Acta, 2003.
S. M. Burkinshaw, “Chemical Principles of Synthetic Fibre Dyeing”, Springer, 1995.
J. Shore, “Practical Dyeing: Fibre Types and Dyeing Processes”, II, The Society of Dyers and Colourists, 2004.
J. R. Aspland, “Textile Dyeing and Coloration”, AATCC, 1997.
H. G. Völz, “Industrial Color Testing: Fundamentals and Techniques”, Wiley-VCH, 2001.
S. J. Kadolph, “Quality Assurance for Textiles and Apparel”, Fairchild Publications, 1998.
B. J. Collier, H. H. Epps, “Textile Testing and Analysis”, Prentice Hall, 1998.
J. Raul, “Textile Testing”, APH Publishing, 2005.
J. Hu, “Fabric Testing”, CRC Press, 2008.

COURSE TITLE	826 - MANUFACTURING OF 2-D FIBROUS PRODUCTS

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the weaving preparation stages that concerns the methods and the machinery of yarn processing, the woven fabric production processes and the various weaving designs used for the production of plain,

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multilayer and specialty fabrics
2. In-depth knowledge and critical understanding of the proper preparation of the yarns for the loom efficiency and the quality assurance of the produced fabric, the woven fabric production technologies on conventional and non-conventional weaving machines and the transformation-transfer processes of a paper design to a woven fabric and vice versa.
3. Knowledge and skills in the elements and the proper settings of the weaving machinery, including the particular aspects of the individual mechanisms of the weaving machines and the proper settings of the woven fabric production machinery.
4. Knowledge and skills of the particular aspects and the prerequisite calculations for the reproduction of woven fabrics

Specifically, students will be able to:

1. Describe and identify the machinery used in the yarn preparation for the weaving process, the machinery used in the woven fabric production and the basic conventional and non-conventional weaving systems as well as the various designs used in the woven fabric production.
2. Explain the operation of the machinery used for the yarn preparation for weaving, both conventional and non-conventional weaving systems and to calculate their operating parameters.
3. Explain the application of each weave design according to the fabric end-use.
4. Develop and specialise the applications of the weaving preparation stages and the weaving systems, to compose and organise new applications and to evaluate the performance of each system.
5. Develop and specialise the applications of the weaving designs, to compose and organise new designs and to evaluate their performance.
6. Implement certification and quality improvement techniques whenever it is required.
7. Apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES
Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the weaving preparation systems' necessities, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the weaving design, weaving preparation, and actual weaving systems operation. Adapting to new situations: evaluation and improvement of the weaving design, weaving preparation and actual weaving systems operation. Decision Making: Synthesis and proper operation of the various machines/processes of the

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weaving design, weaving preparation and actual weaving systems. Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation. Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement. Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility. Work in a multidisciplinary environment: Ability perception problems and needs for optimisation of weaving design, weaving preparation and actual weaving systems and knowledge-solving methods. Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.
1. **SYLLABUS**
2. Principles of the weaving preparation and the woven fabric production systems. 3. Conventional weaving preparation technology, machine standard settings and characteristics. 4. Conventional and non-conventional weaving technologies, processes, machinery, machine standard settings and characteristics. The role of yarn parameters and their effects on woven fabric end-uses. 5. Mechanisms for the weft insertion and blending. Mechanisms for controlling warp and weft yarns. 6. Manufacturing technical specifications/parameters and end-uses of woven fabrics. 7. Design of woven fabrics. Presentation of the weaving process principles and its parameters. Display of designs and fabric appearance. Design classification. Basic designs: Plain, twill, satin. Derivative and processed designs. Display and creation of double face designs. Drawing-in designs, computer punched cards, specifications of the so-produced fabrics. 8. Yarns, colour and weave effects used in warp and weft threads 9. Application of the aforementioned designs on fabrics, analysis and composition of fabrics on experimental looms. 10. Exercises on the production processes. Calculations concerning the production, efficiency and quality characteristics data per process.
TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.

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TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Laboratory exercise: 40%

ATTACHED BIBLIOGRAPHY

R Marks, PJ Lawton, DA Holmes: An Introduction to Textiles: Volume III – Fabrics, School of Textile Studies, Bolton Institute of Higher Education, 1993.
PR Lord, MH Mohamed: Weaving: Conversion of Yarn to Fabric", Merrow, Watford, 1992.
A Ormerod: Modern Preparation and Weaving Machinery, Butterworth & Co. Ltd, 1983.
H Hollstein: Fertigungstechnik Weberei Grundlagen, I, Veb Fachbuchverlag, Leipzig, 1978.
H Hollstein: Fertigungstechnik Weberei Mechanismen, II, Veb Fachbuchverlag, Leipzig, 1980.
H Hollstein: Fertigungstechnik Weberei Webmachinen, III, Veb Fachbuchverlag, Leipzig, 1985.
Autorenkollektiv Gewebe Technik, Veb Fachbuchverlag, Leipzig, 1978.
V John: Shuttleless Looms, The Textile Institute, Manchester, 1980.
O Talavasek, V Svaty: Shuttleless Weaving Machines, Amsterdam, 1981.
Blinov, Shibabaw, Belay: Design of Woven Fabrics, 1988.
HW Kipp: Narrow Fabric Weaving, Salzburg, Sauerlander, 1989.

COURSE TITLE	828 - PRINTING AND DIGITAL PRINTING

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theory of printing, the dyes used and the principles of digital printing.
2. Apply procedures and control of printing, analyze structures, processes and techniques for product optimization and printing quality assurance.

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3. Develop and evaluate methods of printing, maintenance and adjustment of printing equipment, specifications of printing and digital printing. Specifically, students will be able to: 1. Describe and identify the methods, select the structures and equipment of printing. 2. Explain the function of printing machines, assess their capabilities. 3. Compute the parameters of equipment operation, examine the application of printing paste on various substrates. 4. Combine traditional and digital printing processes, plan improvements in dyes and color fastness, develop printing techniques and discriminate between different types of processes. 5. Compose new strategies of digital printing, organize production and printing procedures. 6. Compare batches, evaluate performance and efficiency of printing. 7. Know and apply directives and regulations for environmental protection.
GENERAL COMPENTENCES
1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management. 2. Adapting to new situations. 3. Decision making, ability to criticism and self-criticism. 4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment. 5. Production of new research ideas and free, creative, inductive thinking.
SYLLABUS
Dyes and auxiliaries of printing. Viscosity, printing paste and calculations. Printing machinery. Printing on cotton, wool, polyester, polyamide and cellulose acetate fabric. Industrial methods of Printing. Direct, discharge, resist and dye-sublimation printing. Printing proceeding, drying, steaming, washing. Digital printing, ink classes. Continuous and drop-on-demand inkjet printers. Nozzle systems, piezoelectric, thermal, drop charging. Disperse dye inks, water-soluble dye systems. Colorants in digital printing, color fastness. Print resolution, digital color control. Printing factors and stability, steaming conditions.
TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.

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TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

H. Kipphan, “Handbook of Print Media: Technologies and Production Methods”, Springer, 2001.

S. J. Kadolph, Ed., “Textiles”, 10th Edition, Pearson Prentice Hall, 2007.

J. Tozer, S. Levitt, “Fabric of Society: A Century of People and Their Clothes 1770–1870”, Laura Ashley Press.

J. Fish, “Designing and Printing Textiles”, 2005.

M. Bowles, C. Isaac, “Digital Textile Design”, 2009.

C. Benn, L. Morgan, “Screen Printing: Layering Textiles with Colour, Texture and Imagery”, 2009.

H. Clark, “Textile Printing”, 1985.

J. Storey, “Manual of Textile Printing”, Thames & Hudson Manuals, 1992.

J. Kinnersly-Taylor, “Dyeing and Screenprinting on Textiles”, Printmaking Handbooks, 2003.

“Textile Printing: Woodblock Printing on Textiles, Roller Printing on Textiles, Direct to Garment Printing, Rogan Printing”, General Books LLC, 2010.

M. Rehbein, “Digital Textile Printing and the Influence on Design”, GRIN Verlag, 2010.

H. Ujiie, “Digital Printing of Textiles”, CRC Press, 2006.

R. Shishoo, “Plasma Technologies for Textiles”, Woodhead Publishing Ltd, Manchester, 2007.

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COURSE TITLE	830 - SMART MATERIALS AND INTERACTIVE TECHNOLOGIES

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the use of new technologies in the design of smart textile products.
2. In-depth knowledge and critical understanding of the textile structures that react in environmental conditions and stimuli.
3. Knowledge and skills in the applications of textile materials and products that made by the contribution of sciences (medicine, biology, mechanics, materials) and technologies (electronics, nanotechnology).

Specifically, students will be able to:

- To describe and identify the parts of the smart textile products.
- To explain the operation of a smart textile product and to calculate its operating parameters.
- To develop and specialise the applications of specific systems used in smart textile products, to compose and organise new applications and to evaluate the performance of each system.
- To implement certification and quality improvement techniques whenever it is required.
- To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the necessities of smart textile products, preparation of a feasibility study for the implementation, design, development and supervision of the smart textile products.
Adapting to new situations: evaluation and improvement of the smart textile products's operation.
Decision Making: Synthesis and proper operation of the various parts of the smart textile products.
Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement.
Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
Work in a multidisciplinary environment: Ability perception problems and needs of smart textile products and knowledge-solving methods.
Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

1. Introduction and approach to the smart technology for textiles and ready-made garments
2. Multifunctional textile materials
3. Thermoregulatory textile materials and garments
4. Stimuli-responsive materials
5. Examples of smart textile products
6. Commercial applications developed for medical, protective wear, sports or fun purposes.

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7. Introduction to phase change materials, shape phase material, chromic materials, state change materials, Electro-rheological (ER) fluids etc.
8. Smart Textiles and Wearable technology; description of the differences, evolution, basic functions and examples.
9. Conductive yarns, fiber optics, electro-optics and photonics

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Laboratory exercise: 40%

ATTACHED BIBLIOGRAPHY

M Raheel: Protective clothing systems and materials, Marcel Dekker, Inc., 1994
X Tao: Smart fibres, fabrics and clothing, Woodhouse, 2001
SE Braddock & M O'Mahony: Technotextiles 2 - Revolutionary fabrics for fashion and design, Thames & Hudson, 2005
J Hu: Advances in shape memory polymers, Woodhouse, 2013
MW King, BS Gupta, R Guidoin: Biotextiles as medical implants, 2013
J Hu: Shape memory polymers and textiles, 2007
G Cho: Smart Clothing – Technology and applications, CRS Press, 2010
Y Xu, WJ Li, KK Lee: Intelligent wearable interfaces, Wiley-Interscience, 2008
X. Tao: Smart technology for textiles and clothing –introduction and overview Woodhead, 2003.

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COURSE TITLE	921 - FINISHING AND INTERACTIVE PRODUCTS

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theory of Finishing, the laws of mechanical and chemical treatments, the rules of interactive design, the principles of smart clothing production, the processing of fabric preservation.
2. Apply procedures and control of Finishing, analyze structures, processes and techniques for product optimization and finishing quality assurance.
3. Develop and evaluate the manufacturing of finished products, maintenance and restoration of apparel, special methods and specifications.

Specifically, students will be able to:

1. Describe and identify the methods of Finishing, select components, structures and processes of finishing.
2. Explain the capabilities of interactive technology, assess its prospects.
3. Compute the application parameters of finishing processing, examine the applications of smart clothing.
4. Combine established finishing processes and novel interactive structures, design improvements in properties of smart products, develop clothes of special features and applications.
5. Compose fabric preservation and restoration procedures, organize manufacturing of interactive products.
6. Compare methods and products of Finishing, evaluate the performance of interactive materials.
7. Know and apply directives and regulations for environmental protection.

GENERAL COMPENTENCES

1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management.
2. Adapting to new situations.
3. Decision making, ability to criticism and self-criticism.
4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment.
5. Production of new research ideas and free, creative, inductive thinking.

SYLLABUS

Introduction to mechanical fabric finishing. Anti-shrink treatments. Methods of chemical finishing and finishing products. Softening, sizing, water proofing and water-repellent, flame-retardant, antistatic, moth proofing, easy-care/durable press, shape memory finishing. Special finishes, antimicrobial, insect resist-mite protection. Finishing equipment and special uses. Finishing procedures for woven and knitted fabrics. Comparison of finishing methods and products. Interactive materials and products. Interactive design. Smart and intelligent interactive structures. Conductive polymers, activators. Interactive polymers, fabrics and polymer membranes. Photosensitive fabrics. Extreme cold weather clothing. Heat control, insulation fabrics, thermo-

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regulated, thermosensitive fabrics. Smart fabrics for medical applications. Applications of finishing in design and production of intelligent interactive clothes.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

D. Heywood, "*Textile Finishing*", The Society of Dyers and Colourists, 2003.

W. D. Schindler, P. J. Hauser, "*Chemical Finishing of Textiles*", The Textile Institute, Manchester, 2004.

A. Demir, H. M. Behery, "*Synthetic Filament Yarn: Texturing Technology*", Prentice Hall, 1997.

K. Lacasse, W. Baumann, "*Textile Chemicals: Environmental Data and Facts*", Springer, 2004.

B. Wulfhorst, T. Gries, D. Veit, "*Textile Technology*", Hanser Verlag, 2006.

P. E. Slade, "*Handbook of Fiber Finish Technology*", Marcel Dekker, Inc., 1998.

A. K. Sen, "*Coated Textiles: Principles and Applications*", CRC Press, 2007.

X. Tao, "*Wearable Electronics and Photonics*", Woodhead Publishing Ltd, 2005.

X. Tao, "*Smart Fibres, Fabrics and Clothing*", Woodhead Publishing Ltd, 2001.

L. van Langenhove, The Textile Institute, "*Smart Textiles for Medicine and Healthcare: Materials, Systems and Applications*", CRC Press, Manchester, 2007.

R. Shishoo, "*Textiles in Sport*", Woodhead Publishing Ltd/The Textile Institute, 2005.

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A. R. Horrocks, S. C. Anand, "*Handbook of Technical Textiles*", Woodhead Publishing Ltd, 2000.
P. Vincenzini, R. Paradiso, "*Smart Textiles*", Trans Tech Publication, 2009.

COURSE TITLE	923 - DECOLORATION AND BLEACHING MECHANISMS

LEARNING OUTCOMES

Upon successful completion of the course students are expected to:

1. Thoroughly know and comprehend the theory of light, the laws of reflection and absorption of light, the rules of color mixing, the principles of reducing and oxidizing bleaching, the treatments of optical brightening.
2. Apply procedures and control of bleaching, analyze structures, processes and techniques for product optimization and bleaching quality assurance.
3. Develop and evaluate the adsorption of dyes, the interactions between dyes and adsorbents, maintenance and adjustment of bleaching equipment, methods and specifications of bleaching.

Specifically, students will be able to:

1. Describe and identify the procedures, select the structures and equipment of bleaching.
2. Explain the mechanism of bleaching, assess the reactivity of bleaching agents.
3. Compute the parameters of bleaching solutions, examine the application of adsorbing materials in bleaching systems.
4. Combine traditional bleaching agents and fluorescent brighteners, design modified quality-optimization processes, develop adsorption techniques for dye retention, discriminate between various bleaching conditions.
5. Compose new bleaching methods, organize operation, factors and procedures of decoloration.
6. Compare different bleaching techniques, evaluate the performance of bleaching processes and the efficiency of decoloration practices.
7. Know and apply directives and regulations for environmental protection.

GENERAL COMPENTENCES

1. Search for, analysis and synthesis of data and information with the use of the necessary technology; project planning and management.
2. Adapting to new situations.
3. Decision making, ability to criticism and self-criticism.
4. Working independently, showing social sensitivity, professional and ethical responsibility, with respect for the working and natural environment.
5. Production of new research ideas and free, creative, inductive thinking.

SYLLABUS

Light and radiations. Sources of light. Colored objects. Natural and synthetic dyes. Reflection and absorption of light. Primary, secondary and complementary colors. Additive and subtractive color mixing. Warm, cold and neutral colors. Pretreatments of cotton, wool and blends. Methods of

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preparation for materials to be dyed, based on their end use. Chemical bleaching. General concepts, reducing and oxidizing bleaching agents. Titration of bleaching solutions. Optical brightening. Fluorescent whitening agents and their characteristics. Classification and application of optical brighteners. Bleaching techniques. Bleaching of cotton with hypochlorite salts, hydrogen peroxide and sodium chlorite. Bleaching of flax, wool, silk, regenerated cellulose, polyamides, polyesters, polyacrylonitriles, cellulose acetate. Examination (reflectance and UV-visible spectroscopies) and mechanisms of decoloration. Physical, chemical and biological methods of decoloration. Inorganic and organic absorbents, dye adsorption from liquid systems. Sites, factors, kinetics and isotherms of adsorption. Influence of adsorption on bleaching processes. Dye adsorption, spectrophotometrical features of dye aggregates, monolayer and multilayer self-assembly of dyes, adsorbent–dye interactions.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	90
Laboratory practice	40
Fieldwork	
Essay Writing	
Study	
Course total	**130**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written Examination: 60% • Laboratory Exercise: 40%

ATTACHED BIBLIOGRAPHY

S. R. Karmakar, “Chemical Technology in the Pre-Treatment Processes of Textiles”, Elsevier,1999

K. Lacasse, W. Baumann, “Textile Chemicals: Environmental Data and Facts”, Springer, 2004.

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A. D. Broadbent, "Basic Principles of Textile Coloration", 2001.
J. R. Aspland, "Textile Dyeing and Coloration", AATCC, 1997.
K. Hunger, "Industrial Dyes: Chemistry, Properties, Applications", John Wiley and Sons, 2003.
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B. Wulfhorst, T. Gries, D. Veit, "Textile Technology", Hanser Verlag, 2006.
M. D. Fairchild, "Color Appearance Models", John Wiley and Sons, 2005.
R. W. G. Hunt, "Measuring Colour", Ellis Horwood Ltd, 1991.

COURSE TITLE	924 - 3D MULTILAYER STRUCTURES

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the various specialty woven fabric production processes
2. In-depth knowledge and critical understanding of the various design types used in the production of multiple and specialty woven fabrics.
3. Knowledge and skills of the particular aspects and the prerequisite processes for the transfer of the paper design on the woven fabric and vice versa.
4. Knowledge and skills of the basic technology and behavior of the nonwoven fabrics.

Specifically, students will be able to:

1. To describe and identify the various woven designs of double-multiple fabric width, tubular fabrics, double-multiple and specialty fabrics.
2. To explain the application of each machine/loom for the production of woven fabrics with Jacquard designs (computer punched cards, drawing-in designs, characteristic specifications of the fabrics, yarns used, colour and design warp and weft threads) and to calculate the operational parameters.
3. To develop and specialise the nonwoven production technologies (mechanical, hydroentanglement, electrostatic method). Properties and specifications of nonwoven fabrics. To compose and organise new designs and to evaluate their performance.
4. To implement certification and quality improvement techniques whenever it is required.
5. To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

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Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the specialty fabric design systems' necessities, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the specialty fabric design systems. Adapting to new situations: evaluation and improvement of the specialty woven and nonwoven fabric systems' operation. Decision Making: Synthesis and proper operation of the various machines/processes of the specialty woven and nonwoven fabric systems. Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation. Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement. Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility. Work in a multidisciplinary environment: Ability perception problems and needs for optimisation of specialty woven and nonwoven fabric production systems and knowledge-solving methods. Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.
SYLLABUS
1. Presentation and creation of double-multiple width fabrics, tubular fabrics, double-multiple and specialty fabrics 2. Basic principles of Jacquard designs (computer punched cards, drawing-in designs, characteristics of fabrics, yarns used, colour and design of warp and weft yarns). 3. Differences in properties of woven and nonwoven fabrics 4. Nonwoven production technologies (mechanical, hydroentanglement and electrostatic methods) 5. Specifications for the nonwoven fabric production 6. Design of specialty woven fabric production 7. Design of nonwoven fabric production 8. Exercises on the woven and nonwoven manufacturing processing
TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.

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TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Laboratory exercise: 40%

ATTACHED BIBLIOGRAPHY

Blinov, Shibabaw, Belay, “Design of Woven Fabrics”, 1988.
“Autorenkollektiv Gewebe Technik”, Veb Fachbuchverlag, Leipzig, 1978.
HW Kipp, “Narrow Fabric Weaving”, Salzburg, Sauerlander, 1989.
Medical Textiles”, Bolton Institute of Higher Education, 1997.\
“Needle Punching Technology”, Vaclar Mrstina en Fantisek Feigl, 1990.

COURSE TITLE	**925 - MECHANICS OF FIBROUS STRUCTURES DEFORMATION / ADVANCED QUALITY CONTROL**

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the theory and the principles of the behaviour of the element “fibre”, laying inside yarn structures, during yarn and fabric formation.
2. Knowledge and skills for the evaluation, analysis and comparison of the ideal and real fibre properties and their effects on yarn and fabric properties, following laws, methods and rules of the theoretical and applied mechanics.
3. Knowledge and skills in the elements and the proper processes for the design, implementation and organisation of yarn production based on modern aspects of production management in the textile industry.

   Specifically, students will be able to:
4. To describe and identify the various ideal forms of the textile structures.
5. To explain the mechanisms of most textile structures.
6. To develop and specialise the applications of destructive and non-destructive methods for the determination of the textile structures technical specifications.

GENERAL COMPENTENCES

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Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the non-destructive textile quality control testing systems by the use of mathematical models, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the non-destructive textile quality control testing systems operation. Adapting to new situations: evaluation and improvement of the non-destructive textile quality control testing systems' operation. Decision Making: Synthesis and proper operation of the various non-destructive textile quality control testing systems. Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation. Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement. Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility. Work in a multidisciplinary environment: Ability perception problems and needs of non-destructive textile quality control testing systems and knowledge-solving methods. Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.
SYLLABUS
1. Yarn geometry – ideal helix structure, linear density, specific volume, twist, twist angle, twist factor, yarn contraction due to twist - , packaging and arrangement of fibres into a yarn 2. Fibre migration – mechanism, characteristics, tracer fibre technique. 3. FIbre and yarn behavior during tensile strength testing, yarn compression and bending, yarn torque, crimp frequency of false-twist textured yarns. 4. Elementary mechanics applied to bicomponent fibres and false-twist textured cont. filaments 5. Peirce theory on woven and knitted fabric geometry 6. Tear and elastic behavior of fabrics. 7. Methods and techniques of analytical and computational yarn and fabric modelling. 8. Choice of nets for computational modelling. 9. Parametric computational representations of the three-dimensional structures 10. Importance of the boundary conditions & enforcement techniques freight for each stress mode 11. Applications of Acoustics Technology and Image analysis – microscopy for non-destructive quality control of textiles
TEACHING and LEARNING METHODS - EVALUATION

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TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Laboratory exercise: 40%

ATTACHED BIBLIOGRAPHY

1. JWS Hearle, P Grosberg, S Backer: Structural Mechanics of Fibers, Yarns and Fabrics, Wiley, 1969
2. BC Goswami, JG Martindale, FL Scardino: Textile Yarns: Technology, Structure and Applications, J. Wiley & Sons, New York, 1977
3. JWS Hearle, JJ Thwaites, J Amirbayat: Mechanics of Flexible Fibre Assemblies, Sijthoff & Noordhoff, Alphen aan den Rijn, The Netherlands, 1980
4. R Postle, GA Carnaby, S de Jong: The mechanics of wool structures, Ellis Horwood Ltd., 1988
5. P Grosberg, C Iype: Yarn production - Theoretical aspects, The Textile Institute, 1999
6. JWS Hearle, L Hollick, DK Wilson: Yarn texturing technology, Woodhead, 2001
7. J Hu: Structure and mechanics of woven fabrics, Woodhead, 2004
8. P Schwartz: Structure and mechanics of textile fibre assemblies, Woodhead, 2008
9. X. Chen: Modelling and predicting textile behavior, Woodhead, 2010

COURSE TITLE	**926 - MANUFACTURING OF SPECIALIZED PRODUCTS**

LEARNING OUTCOMES

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of the post-spinning yarn processes and non-conventional spinning processes for the production of specialty yarns.
2. Knowledge and skills in the elements and the proper settings of the various post-spinning and non-conventional spinning machines.
3. Knowledge and skills in the elements and the proper processes for the design, implementation and organisation of yarn production based on modern aspects of production management in the textile industry.

Specifically, students will be able to:

1. To describe and identify the machinery used in post-spinning yarn processes and non-conventional spinning processes.
2. To explain the operation of every machine in post-spinning yarn processes and non-conventional spinning processes for the production of specialty yarns and to calculate their

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operating parameters
3. To develop and specialise the applications of post-spinning yarn processes and non-conventional spinning processes used for the production of specialty yarns, compose and organise new applications and to evaluate the performance of each system.
4. To implement certification and quality improvement techniques whenever it is required.
5. To know and apply the rules and recommendations related to environmental protection.

GENERAL COMPENTENCES

Search, analysis and synthesis of data and information, using the necessary technologies: Studies of the yarn post-spinning and non-conventional spinning systems' necessities, preparation of a feasibility study for the implementation and use of these systems, i.e., design, development, installation, support and supervision of the yarn post-spinning and non-conventional spinning systems operation.
Adapting to new situations: evaluation and improvement of the yarn post-spinning and non-conventional spinning systems' operation.
Decision Making: Synthesis and proper operation of the various machines/processes of the yarn post-spinning and non-conventional spinning systems.
Autonomous work: Knowledge of regulations, protocols and ethical issues when developing innovation.
Teamwork: Ability for dialog, self- esteem and commitment to reach an agreement.
Working in an international environment: Communication skills in international languages, respecting diversity, multiculturalism and the environment. Demonstration of professional and ethical responsibility.
Work in a multidisciplinary environment: Ability perception problems and needs of yarn post-spinning and non-conventional spinning systems and knowledge-solving methods.
Generate new research ideas: Promoting free, creative and inductive thinking to develop new strategic approaches.

SYLLABUS

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1. Principles and technologies of yarn post-spinning and fancy yarn system processes.
2. Distinctive technological characteristics of the various types of fancy yarns.
3. Principles, technologies and modern aspects/variations of conventional short-staple spinning systems.
4. Principles, technologies of non-conventional short-staple spinning systems (OE, Airjet, Friction).
5. Distinctive technological characteristics of the various types of non-conventional yarns.
6. General principles of production organisation of textile enterprises. Quality assurance system ISO. Philosophy of Total Quality Management (TQM).
7. Principles of establishment of the textile enterprise. Systems for the determination of productivity. Applied costing techniques for textile products and services.
8. Application of Quick Response, Right First Time and Just in Time principles in textile enterprises.
9. Modern electronic and computerised remote surveillance and control systems in textile companies. Hierarchical structures of industrial information systems – typical textile examples. Computer networking elements. Computerised integrated production control systems.
10. Design and execution of production on demand specialty yarn using non-conventional spinning systems.
11. Design of yarn production. Exercises on production processing.
12. Design of an experiment concerning the effect of various non-conventional yarn production factors on its technical characteristics based on yarn quality control results. Calculations of yarn production, efficiency and QC data.
13. Exercises of design/programming of electronic and computerised remote surveillance and control systems.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY:	Face to Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	39
Laboratory practice	26
Fieldwork	
Essay Writing	**26**
Study	**29**
Course total	**120**

STUDENT PERFORMANCE EVALUATION	**Language of Evaluation:** Greek **Methods of Evaluation:** • Written examination: 60% • Laboratory exercise: 40%

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ATTACHED BIBLIOGRAPHY
11. W Klein: New spinning systems, The Textile Institute, 1987 12. CA Lawrence: Advances in yarn spinning technology, Woodhead, 2010 13. H Deussen: Rotor spinning technology, Schlafhorst Inc., 1993 14. PR Lord: Handbook of yarn production, The Textile Institute, 2003 15. JWS Hearle, L Hollick, DK Wilson: Yarn texturing technology, Woodhead, 2001 16. RH Gong and RM Wright: Fancy yarns, Woodhead, 2002 17. VD Dudeja: Management of textile industry, Textile Trade Press, 1981 18. RL Flood: Beyond TQM, J. Wiley & Sons, 1993 19. MJ Fox: Quality Assurance Management, Chapman and Hall, 1993 20. F Price: Right First Time, Gower, 1994

COURSE TITLE	930 – DESIGN & DEVELOPMENT OF PRODUCT COLLACTIONS

LEARNING OUTCOMES

Upon completion of the course students will have:

1. Clothes collection design and development skills.
2. Organize Collections based on different materials.
3. Ability to select the production line according to the final product.

In detail, students will be able to:

1. Develop technical and creative concepts for designing originally inspired collections.
2. Combine the appropriate fabrics & design patterns for the creation of clothing models.
3. Apply proper technologies and plan the required processing stages and production machines.
4. Manage the behavior of the various materials used in clothes making.

GENERAL COMPENTENCES

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Troubleshooting
- Decision making
- Teamwork
- Work in an international environment

SYLLABUS

- Development of ideas, fashion illustration, correlation with textile technology, construction details, market research and business modeling.
- Study and understanding of basic principles of design theory in clothing.
- Design as a means of visual communication of ideas.
- Visual stimuli, interpretation and utilization of point theory.
- The composition and combination of elements for the transmission of messages in the design of clothes by direct and effective ways.

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– Development of design ideas through the interpretation of architecture, colors, nature, technology, culture.
– Experimental investigation of aspects of the human silhouette and the search for a "personal style" to create a modern proposal.
– Research and data collection to create a pioneering thematic laboratory project.
– Composition of dress codes and trend principles in preparing and presenting a modern Portfolio.
– Fashion and Technology.

Laboratory part of the lesson:

Basic skills in drawing construction, TREND-BOARDS, COLLECTION-BOARDS, TEXTILE-BOARDS, Research, Development in CAD, 2D design in 3D processes, Fabrics and materials, Use of color.

Comprehensive overview, selection, organization and presentation of small thematic collections.

Implementation of a personal collection with proposals of materials, accessories and color palettes.

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DELIVERY:	Face to Face. Team working in laboratories.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY:	Use of ICT in teaching, laboratory education, communication with students.
TEACHING METHODS	

Activity	Semester Workload
Lectures	60
Laboratory practice	30
Educational visits	15
Essay Writing	15
Study	20
Course total	**120**

STUDENT PERFORMANCE EVALUATION

Language of Evaluation: Greek

Methods of Evaluation:

- Written Examination: 50%
- Laboratory Exercise: 50%

ATTACHED BIBLIOGRAPHY

1. H. Eberle, H. Hermeling, M. Hornberger, “Fachwissen Bekleidung”, Europa-Lehrmittel, 2007.
2. C. Vindersvon, “Introduction to a Study Concept: Lehramt an Berufskollegs im Fach Bekleidungstechnik ”, Akademikerverlag, 2011.
3. S. J. Jones, “Fashion Design (Portfolio)”, 2011.
4. J. Sissons, “Basics Fashion Design: Knitwear”, 2010.
5. G. Cooklin, "Introduction to Clothing Manufacture", 1991.
1. H. Carr, B. Latham, “The Technology of Clothing Manufacture”, 2nd Edition.
2. D. D'Ortenzio, "Free Fashion Design - Sketches", 1999.

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3. W. Aldrich, "Design and Cutting of Women's Clothing", 2009.

2.2 International Hellenic University, Creative Design and Clothing

The International Hellenic University is based in Thessaloniki (Greece) and comprises nine (9) Schools and thirty-four (34) Departments distributed in various locations of North Greece. The IHU was Greece's first public university that offered master programmes exclusively in English (24 master programmes in three Schools). The Creative Design and Clothing department is located in the city of Kilkis and together with the department of Interior Architecture constitute the "School of Design Sciences**".**

2.2.1 Basic Information

The Creative Design and Clothing department operated for first time in the academic year 1999-2000 and the only higher education department in Greece, focusing entirely in Fashion Design & Clothing Technology. The department offers a four (4) year Bachelor degree and is in close cooperation with social partners of the Greek Fashion sector.

- It provides academic knowledge and skills at the undergraduate level, in the field of creative design in Clothing, according to the standard of European undergraduate level curricula.
- Collaborates with the production units of the Clothing Market and bodies related to the Clothing sector.
- Uses modern technologies in education.
- Monitors international developments in the scientific and academic field and integrates them in a dynamic way in the educational process & Research.
- Participates in events and competitions in order to develop students' creativity and their constant contact with the fields of art and technology.
- Contributes through its curriculum and Research to sustainable development and the circular economy.
- Collaborates with higher education institutions in the country and abroad.
- Has succeeded in attracting students from the Balkans and internationally and looks forward, in the future, to the provision of education in a foreign language (English)

2.2.2 Learning Objectives

The primary objectives of the Department are:

- to produce graduates who will be able to develop art, rely on science, creatively use new technologies, to design functional and innovative Clothing products with added aesthetic, technological or ecological value.

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- to provide its students with competitive knowledge and skills necessary for their scientific and professional career and development in the clothing industry both at the industry level and in academia.
- to promote Research on contemporary issues related to the Design and development of PC & Clothing products, as well as their Aesthetics.
- to preserve and highlight the special characteristics of the cultural heritage of Greece in terms of Clothing, Fabric and their techniques, as they are developed through local traditional arts and crafts.
- to contribute aesthetically to the development and modernization of traditional processes of Design and manufacture of Garment, with the use of Technology and in the context of international trends.
- to contribute to a modern attitude and philosophy regarding the character and function of the Garment, as a product of sustainability and cultural heritage.

2.2.3 Study plan of the bachelor's degree in Creative Design and Clothing

The fields of the four (4) year Bachelor studies in the Creative Design and Clothing department are:

- • Fashion Design
- • Clothing Technology
- • Fashion Marketing

The curriculum is divided into eight semesters, 2 per year, and it includes both compulsory and optional subjects, which corresponds in total to 240 ECTS.

The overall curriculum is presented in the next table:

Bachelor in Creative Design and Clothing

Semester 1		**ECTS**
101-	Freehand drawing	5
102-	Principles and Applications of Somatometry	4
103-	History of Art and Clothing I	6
104-	Physics and Chemistry of Materials & Paints	5
105-	Principles of Digital Design	5
106-	Mathematical Methods in Design	5
Semester 2		**ECTS**
201-	Color and Pattern Composition	4
202-	Garment Products Design	4
203-	History of Art and Clothing II	6
204-	Science of Fibers and Yarns	6

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205-	Technical Sketch	5
206-	Principles of Garment Making	5

Semester 3		**ECTS**
301-	Fashion Forecast and Design	5
302-	Design and Technology of Garment Patterns I	5
303-	History of Modern Fashion	5
304-	Fabric Structures	6
305-	Digital Fabric Design	5
306-	Principles of Fashion Marketing	4
Semester 4		**ECTS**
401-	Conception and Development of a Design Idea	5
402-	Design and Technology of Garment Patterns II	6
403-	Semiology of Style	4
404-	Textile Processing	6
405-	Textile and Clothing Statistics	4
406-	Communication and Promotion Strategies	5
Semester 5		**ECTS**
501-	Design and Technology of Garment Patterns III	5
502-	Aesthetic Theories	5
503-	Costing Methods	5
504-	Quality Control I	5
505-	Brand Management	5
Elective subject : 1 out of 3		
506-	Haute Couture Techniques in Clothing	5
507-	Clothing Production Process Management	5
508-	Corporate Markets in Retail	5
Semester 6		**ECTS**
601-	Electronic Systems for Pattern Design	5
602-	Contemporary Art and Design	5
603-	Virtual prototype	5
604-	Quality Control II	5
Elective subject : 2 out of 6		
605-	Design and Development of Clothing Collections	5
606-	Intelligent Clothing Systems	5
607-	Visual Merchandising	5
608-	The Communication of Clothing	5

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609-	Operational research	5
610-	Clothing Supply Chain Management	5

Semester 7		**ECTS**
701-	Greek Folk Culture and Costume	5
702-	Fashion consumer behavior	5
703-	Digital Marketing	5
704-	Research Organization and Methodology	5
705-	Clothing Business Administration	5
Elective subject : 1 out of 3		
706-	Creating a Collection and portfolio	5
707-	Modern Applications in Production Management	5
708-	Product Development for the Circular Economy	

Semester 8		**ECTS**
	Thesis	20
	Internship or 2 of the following elective courses	10
Elective subject :		
801-	Rapid Prototyping Systems	5
802-	Advanced Materials Science and Technology	5
803-	Life Cycle and Resource Management Systems	5
804-	Entrepreneurship and Innovation	5

2.3 Conclusions - Textile Bachelor's Studies

Two textile-oriented Bachelor degree programs are available in Greece. The first program - University of West Attica, Industrial Design and Production Engineering dept.- aims to the creation of Industrial Production Engineers with specialization in the textile industry, through the selection of a studies-path dedicated to Textile and Garment Engineering. This studies-path deals with advanced topics of the modern textile industry, such as advanced materials and processing, high-performance textiles and smart textiles. The overall curriculum leads to the profile of a production engineer capable to build a career in the textile industry, as well as in other sectors. The second program -International Hellenic University, Creative Design and Clothing dept.- focus mainly on Fashion design and Garment manufacturing, and has a lower relation with the subjects of advanced and smart textiles. The size of the Greek Textile industry has significantly reduced during the last years of economic recession. On the other hand, the Greek garment manufacturing has

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been proved less sensitive. Due to this, the graduates of the Creative Design and Clothing department meet a higher demand in the labor market. However, the advancements in the wearable technologies and business models is expected to increase the demand for engineers with specialization in textiles in the next years.

3. Textile Master's studies

At the moment, there is no textile-oriented Master degree program available in Greek HEI. However, the "Industrial Design and Production Engineering" department of University of West Attica, will soon participate in the international collaborative Master degree program: **Textile Engineering Advanced Master 'WE-TEAM'**.

The 'WE-TEAM' Master is organized by a consortium consisting of six (6) full partners (Universiteit Gent, Kyoto Institute of Technology, University of Haute-Alsace, University of Borås, University of West Attica, University of Valencia) and five (5) associated partners (Ecole Nationale Supérieure des Arts et Industries Textiles, Lodz University of Technology, Shinshu University, Technical University Dresden, Kaunas University of Technology). The Master program will be implemented with courses that will be delivered in the six different locations of the six full partner Universities, thus empowering mobility and international collaboration. The curriculum of the Master program offers 120 ECTS and is presented in the next table:

Textile Engineering Advanced Master 'WE-TEAM'

Semester 1	**ECTS**
Polymer Technology	3
Advanced Fibre Technology	3
Biomaterials	3
Mechanics of Textile Materials	3
Instrumental Analysis	3
Computation Sciences and Engineering Principles	6
Composite Materials	3
Dyeing	3
Introduction to Co-creation	3
Semester 2	**ECTS**
Mechanical processing	9
Finishing	3
Biotechnology	3
Nanotechnology	3

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Automation and Process Control	3
Garment Technology	3
Industrial Information Systems	3
Elective course	3

Semester 3	**ECTS**
Application of Technical Textiles	6
Technical Textile Manufacturing	3
Innovative garment manufacturing	3
Comfort and Computation of Textiles	3
Intelligent Textiles	3
Sustainable Textile Design	3
Management, Logistics and Distribution	6
Scientific Thinking	3
Semester 4	**ECTS**
Master's dissertation	30

Information about the **Textile Engineering Advanced Master 'WE-TEAM'** can be found in the official site: **https://we-team.education**

3.1 Conclusions - Textile Master's studies

Until today, the graduates in Greece who are interested in a textile Master degree have the only option of following a Master program abroad. The new Textile Engineering Advanced Master 'WE-TEAM', which will be implemented partially in Greece, is expected to cover this gap and give the Greek textile professionals the opportunity to increase their specialization in the state-of-art textile technologies. Moreover, the structure and methodology of this Master will multiply the potential of future international collaborations and research.

4. Final Conclusions

The textile-oriented undergraduate studies in Greece are offered by two departments. Each of them offers comprehensive knowledge and skills in a different sub-sector of the textile industry ecosystem. The first focuses on materials, industrial processing, machinery, automations and production management, while the second focuses on fashion design, garment manufacturing and fashion trade. The higher specialization with a Master degree is still missing, however both

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departments aim to achieve a specialization through more advanced elective subjects, project-based activities and a final thesis, which is also elective. The new Textile Engineering Advanced Master 'WE-TEAM', in which the department of Industrial Design and Production of UNIWA participates as full partner, is expected to extend the specialization of graduates in the fields of advanced materials, smart textiles, high-tech applications and innovative business models.

5. Introduction – BELGIUM

In this work, an analysis of the textile study plans of Ghent university, Belgium will be carried out, focusing in depth on Textiles and materials science engineering. These training programmes are intended to train professionals in the textile and materials sector, especially in the field of technical and smart textiles applied in various sectors such as medical, industrial, construction, ecological protection, sports, electronics etc.

The need for this type of professionals is increasing, due to the current demand for technical textiles experts capable of maximizing the potential of textiles. The proper combination of this type of products and its continuous improvement results in high-performance materials and products with amazing properties, multiplying their applications.

For this reason, universities and teaching organizations want to improve their study systems, in order to train the best professionals, offering them adequate content that will serve as the basis for their future work.

The offer of this type of available studies in Belgium is mainly focused in two main programme in Ghent University, namely the **Master of Science in Sustainable Materials Engineering** and the international **Master of Science in Textile Engineering**.

The Master of Textile Engineering diploma leads to a variety of employment opportunities in which knowledge of textiles in the broadest sense of the word is discussed. Students acquire a thorough understanding of all facets related to textiles and as a result are well prepared for jobs requiring a broad knowledge of textiles. Graduates can opt for careers in academia or industry.

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In the Master of Science in Sustainable Materials Engineering, *Major Polymers and Fibre Structures* focuses on polymers, especially on fibre based structures. Polymers are the main raw material of fibres, next to ceramic and mineral ones. The programme covers the materials and their physical, chemical and mechanical processing and treatment. Emphasis is put on the technology, the behaviour of the fibres and yarns during processing and the fundamental properties of the structures. By providing a physical or chemical after treatment to textile materials, additional properties (added value) can be achieved. The theory of colour, colour formation and perception and the treatment of different dye types including their application are described. As such, students obtain an understanding of textile materials and processes with special attention to the development of products with specific functionalities (flame retardant, crease resistant, antibacterial, soil resistant …). Nanotechnology and biotechnological materials and processes are discussed. A lot of attention is also paid to the development of artificial turf for sports and other recreational purposes. A specific type of functional materials relates to intelligent (interactive) textile materials. Thematic clusters of elective courses offer students the possibility to further concentrate on specific materials (possibly from the other Materials major, *Metal Science and Engineering*), or on specific themes such as ecology, nanotechnology, smart materials, chemistry or business oriented technical and non-technical topics.

In the majors students have two possibilities: either an advanced programme of materials sciences or a more broad approach (by choosing a Minor) which – next to a thorough study of materials science – gives the opportunity to specialise in one of the following fields: Management, Environment and Sustainable Development, Automotive Production Engineering.

Graduates (Masters in Materials Engineering) –like all other engineers (Masters in Engineering)– have a wide range of possibilities. The demand for engineers (MSc in Engineering) exceeds the number of graduates available including material science engineers. Graduates have careers in industry, public service or scientific research. Fundamental and applied scientific research concentrates on the properties, the behaviour, the processing and the production of different types of materials, such as metals, synthetic materials, ceramics, composites and 'new' materials. Others analyse and optimise existing or new production and processing methods. Researchers can work in academic and industrial research centres. In industry, material science engineers have

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technical, commercial or management positions. Textiles and polymers also belong to materials engineering. The textile and clothing sector is still one of the main industries and a growing sector. Innovation and development of advanced products for new markets and the application of new technologies are essential for a healthy industry. This requires an increasing number of Masters in Engineering with a specialisation in Materials Engineering. They hold leading positions in the development, production and sale of advanced textile materials. Such textile materials are used in almost all industries, from beverages and food to foams, electronics, pharmacy, medicine, agriculture, transport (e.g. composites) etc. In these industries, job opportunities are available for material science engineers as well.

6. Master of science in Textile Engineering

The Master of Science in Textile Engineering course is a two-year course in the field of textile technology, developed within the framework of and sponsored by the Socrates program of the European Union. It was and still is a unique program offering advanced textile education with consideration to the most recent improvements in the field of textiles and with sufficient attention to a multidisciplinary approach.

To this end, the most renowned education specialists (in Europe and beyond) are brought together. The program can rely on significant input from industry. Graduates possess the knowledge, skills and attitudes that ensure their impact on technological innovation, creativity, quality and management in both industry and academia. The focus is not only on knowledge acquisition, but also on personal development and networking, with special attention to the international dimension.

6.1 General Structure

The program is full-time, taught in English and hosted in a variety of locations. The main universities in Europe (and beyond) that offer textile education participate in the program. The program thus makes full use of the strengths of already existing textile training and pays attention to all modern areas of the textile discipline.

The first three semesters are organized by three different universities (= host universities). The last and thus the fourth semester of the two-year program is fully spent on the master's thesis at one of the participating universities (to be chosen by the student) under the supervision of a supervisor, possibly in collaboration with the industry.

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From the 2020-2022 edition (starting in academic year 2020-2021), the first semester will always be organized at Ghent University, the second semester will rotate between University of West Attica (Greece), Universitat Politècnica de València (Spain) and Ecole Nationale Supérieure des Ingénieurs Sud Alsace (France) while for the third semester the students can choose between University of Borås (Sweden) and Kyoto Institute of Technology (Japan).

Students who are admitted thus spend a year and a half (three semesters) in three geographically dispersed regions, where they are taught by a large number of professors from the participating universities and also involve industry. Each teacher passes on his or her specific knowledge of a particular domain in a module that takes one or two weeks to complete. In addition to the classic teaching methods, active teaching methods are also used such as blended learning, case studies, projects, practicals in laboratories, etc. Industry is strongly involved in linking theory to practice.

6.2 Admission Requirements

As this master is joint over several universities, it does not have a fixed bachelor, but instead has admission requirements. Students can subscribe to the master at one of the host universities. For UGent the admission requirements are:

Immediate Admission

- Bachelor of Bioscience Engineering
- Bachelor of Engineering, Specialization: Chemistry and Materials
- Bachelor of Engineering, Specialization: Chemical Engineering
- Bachelor of engineering sciences, specialization: chemical technology and materials science
- Bachelor of Engineering, Specialization: Materials Science
- Bachelor of Engineering: Chemical Engineering and Materials Science
- Master of Industrial Sciences: Chemistry
- Master of Industrial Sciences: Industrial Design
- Master of Industrial Sciences: Textile Technology
- Master of Chemical Engineering Technology

Upon Approval by the Faculty: Immediate Admission

- Master of Chemistry

Admission Subject to Passing a Preparatory Course

- Bachelor of bio-industrial sciences

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- Bachelor of Industrial Sciences, specialization: chemistry
- Bachelor of Industrial Sciences, specialization: electromechanics
- Bachelor of Industrial Sciences: Chemistry
- Bachelor of Industrial Sciences: Electromechanics
- Bachelor of Industrial Sciences: Plastics Processing
- Bachelor of Industrial Sciences: Textile Technology
- Bachelor in de ingenieurswetenschappen (KMS)
- Bachelor of Engineering Technology, specialization: Chemical Engineering
- Bachelor of Engineering Technology, specialization: Electromechanical Engineering
- A degree in 'Master in Engineering Technology'
- A degree in 'Bachelor of Science in Engineering (including 'architecture')
- A degree in 'Master of Science in the industrial sciences'

Admission Procedure for Students holding a Non-Belgian Diploma

Information on admission requirements and the administrative procedure for admission on the basis of a diploma obtained abroad, can be found on the following page: https://www.ugent.be/admission

Language Requirements

Language requirements for this study programme differ from the required standard level for English taught study programmes as specified in the Ghent University Education and Examination Code.

For English it is required to have obtained: TOEFL 550 (paper-based) - TOEFL 79 (internet-based) - TOEFL 213 (computer-based) - IELTS: 5.5 - UCT-attest (level B2) - a certificate confirming that the prospective student passed one year or at least 60 credits of study in an English-language study programme in either secondary or higher education

6.3 Complete Programs

The degree has a duration of 2 years and it contains a total of 120 ECTS credits, which are structured as follows:

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Table 1. Structure of the ECTS credits

	ECTS	Semester
General courses		
Polymer Technology	3	1
Advanced Fiber Technology	3	1
Biomaterials	3	1
Mechanics of Textile Materials	3	1
Instrumental Analysis	3	1
Computation Sciences and Engineering Principles for Textiles	6	1
Composite Materials	3	1
Advanced and Specialized Textile Processing - Dyeing	3	1
Introduction to Cocreation [en, nl]	3	1
Advanced and Specialised Textile Processing - Mechanical	9	1
Advanced and Specialised Textile Processing - Finishing	3	2
Biotechnology	3	2
Nanotechnology in the Textile Branch	3	2
Automation and Process Control	3	2
Garment Technology	3	2
Industrial Information Systems	3	2
Application of Technical Textiles	6	2
Technical Textile Manufacturing Technology	3	3
Innovative Methods for the Product Development Process for Garments and Technical Applications in the Ready-Made Industry	3	3
Comfort and Computation of Textiles	3	3
Intelligent Textiles	3	3
Sustainable Textile Design	3	3
Management, Logistics and Distribution	6	3
Scientific Thinking	3	3
2- Elective Courses		
Internship 1 [en, nl]	3	A:1 B:2
Internship 2 [en, nl]	3	A:1 B:2

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Internship 3 [en, nl]	6	A:1 B:2
International Internship 1	3	A:1 B:2
International Internship 2	3	A:1 B:2
International Internship 3	6	A:1 B:2
Specialist Course	3	A:1 B:2
Master Dissertation		
Master's Dissertation	30	COMPULSORY

6.4 First semester courses

The degree master of textile engineering can lead to different courses involving textile knowledge in the broadest sense of the word. Students obtain a thorough understanding of all aspects related to textiles and are hence well-prepared for jobs requiring elaborate knowledge in textiles.

6.4.1 Polymer Technology

The course covers fundamental descriptions but in view of the scope of this Master program focus is on the conceptual framework and more basic case studies for the application of this framework. The production of fibers and polymers requires dedicated processing/manufacturing techniques. The main aspects of these techniques are covered, considering all relevant length scales. It covers Introduction to polymer physics and different polymer length scales. Nanoscale mathematical description root mean square end-to-end distance and radius of gyration, thermodynamical properties, Viscoelastic properties and rheological behavior, basic models based on constant strains or stresses, dynamic testing to assess key polymer properties, fundamentals of polymer melt flow etc.

6.4.2 Advanced Fiber Technology

The purpose of this course is to describe and explain main properties of textile fibers and knowledge on properties and use of textile fibers. Make the students enable to select the proper fibers for a specific use. The production of fibers and polymers requires dedicated processing techniques. This course addresses the textile fibers, types and general properties of fibers, natural fibers, synthetic fibers, high tech fibers, high-performance Polyethylene fibers, polyketone fibers,

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Polyphenylene Sulfide Fibers, Aromatic Polyester Fibers, Carbon Fibers, Aramid Fibers, Polyimide Fibers, Fibers from Aromatic Heterocyclic Polymers, Glass Fibers, Basalt Fibers , Ceramic Fibers etc.

6.4.3 Biomaterials

The purpose of this course is to obtain an overview of biopolymers generally used for materials' applications. To get insight into the chemistry and surface modifications, and transformation to bio products. In general, obtain an understanding of biopolymers, their characteristics and applications. It includes overview of textile fibres: Fibre theory, Natural fibres (cotton, flax, jute, wool, silk), manufactured fibres (rayon, cellulose acetate, lyocell, polyester, nylon, kevlar, polypropylene, vinyl fibres, acrylic); fibre classification, fibre structure, surface modification.

6.4.4 Mechanics of Textile Materials

The purpose of this course is to develop an understanding of the structural and continuum mechanics of yarns and fabrics, through a study of relevant theoretical models, experimental research findings and practical industrial experiences. It includes continuum approach to textile materials, yarn mechanics, woven fabric mechanics, knitted fabric mechanics. Development of an understanding of the structural and continuum mechanics of yarn and fabrics.

6.4.5 Instrumental Analysis

The course covers fundamental descriptions of Rationale for Analytical Analysis, Infrared and Raman Spectroscopy Electron Microscopy, X-Ray Microanalysis, Confocal Microscopy and Atomic Force, Microscopy, X-Ray Photoelectron Spectroscopy, Secondary Ion Mass Spectrometry, Matrix, Assisted Laser Desorption, Thermal Analytical Techniques and Mechanical Relaxation Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, X-Ray Diffraction and Neutron, Scattering, Molecular Weight Distribution, GPC and Viscosity Properties, Separation Techniques, HPLC, GC and CE, BSc level in mathematics, organic chemistry, physical chemistry, general process engineering, textile technology and materials engineering.

6.4.6 Computation Sciences and Engineering Principles for Textiles

Computation science is still a growing multidisciplinary field of science that uses advanced computing capabilities to understand and solve complex problems. Manipulation of textiles is such a complex problem. This course aims at providing the basic understanding of mechanisms and tools regarding various types of textile modelling. The course addresses the use properties of clothes, mainly related to interaction with the wearer in a broad sense. The first part of the course

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addresses the modelling approaches to textiles. Integration of physical, chemical, mathematical, and computational sciences and engineering principles lead to better understanding the behavior of textiles during processing and use. Apart from fashion, clothes and other textile products are used in a variety of applications with in the case of technical textiles sometimes extreme conditions during use. They target human healthy lifestyles with functions aimed at comfort, protection, prevention, diagnosis and treatment of disease, and improving health. However, such advanced materials and structures will influence the material properties of materials in sometimes unexpected ways. This might lead to a decreased wear or use comfort in many ways. Good understanding of the engineering principles and of modelling tools are of great importance to obtain a proper design of textile products, which significantly improves wear comfort, lifetime, and application possibilities.

The second part of the course addresses the computational tools. In this context, computational science merges the following elements: numerical methods, modelling and simulation. Different software developed to solve science problems in the context of textiles is presented (e.g. Abaqus, Texgen, DySiFil, Texmind). In order to model a textile object, the student will be presented the basic mechanical parameters of selected textiles and will be able to introduce them into a modelled textile object. By changing different parameters, they will learn modelling of textiles and how it leads to better understanding the phenomena.

6.4.7 Composite Materials

This course covers knowledge in the domain of composites and application of textile fibers in developing composites for different field of applications, their manufacturing technologies.

- Weaving and Braiding Technologies for composites
- Three Dimensional Reinforcing Structures
- Load Bearing Textiles and Sandwich Structures
- Wetting Technologies

6.4.8 Advanced and Specialized Textile Processing – Dyeing

This allows for the students to already gain knowledge in fiber materials. This knowledge will be further deepened in this course towards the dyeing and printing of fiber materials. The aim of this course unit is to educate the students on the main aspects of fiber material coloration. A first part is dedicated to how color can be quantified. A second part is dedicated to the thermodynamics and the kinetics of dyeing processes. A third part applies this knowledge to the most important

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textile materials, including examples of novel applications. Finally dyeing and printing equipment is discussed.

6.4.9 Introduction to Cocreation

An important objective of the university is to stimulate multiperspectivism. Transdisciplinary research is the eminent method for bringing engaged stakeholders from various courses and disciplines together. In a transdisciplinary collaboration, the individual disciplines are no longer recognizable and, for example, problems are solved by using elements from different disciplines where collaboration and integration are more important than the discipline itself. Interaction and mixing are essential to be able to speak of transdisciplinarity.

At UGent there is a lot of top knowledge and expertise, but often it is only used in the silos of the in-house programmes. With this transdisciplinary project we want to break through these silos by allowing teachers and students from different fields to work together. To maximize the effect of the efforts, a topic is put forward annually (for example in 2016: 'improved quality of life through enabling technology').

Next to an overview of various theoretical principles of co-creation, design thinking and input from various disciplines, the whole is tested against an actual project that the student can choose from according to his/her own interest.

The project broadly covers the basic vision of design thinking that focuses on user centered design. A co-creation design method is followed in which all students from the various disciplines are assigned an equal and important role, but are also able to interact and integrate the results into one whole.

6.5 Second semester course

6.5.1 Advanced and Specialized Textile Processing - Mechanical

To obtain an understanding of various aspects related to spinning including latest developments; understanding of weaving procedures and mechanisms, weaving processes, manufacturing; deepen the knowledge in the field of pneumatic systems, pneumatic automation circuits.

6.5.2 Advanced and Specialized Textile Processing – Finishing

This course unit aims to educate the students on the main aspects of finishing of textile materials through detail knowledge of fabric preparation for its finishing processes. Various aspects of

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several textile auxiliaries and enzymes are part of understanding. Different textile printing processes and after treatment processes are also among the main objectives of this course.

6.5.3 Biotechnology

The main goal of this course is to obtain an overview of the characteristic aspects of biotechnology and the application in textile processing, especially through detailed knowledge transfer of different enzymes, their properties, and functions in textile processing. Also micro-organisms and cells are considered.

6.5.4 Nanotechnology in the Textile Branch

Upon successful completion of the course, the students will be able to understand the principles of nano techniques used in different textile processes and know the developments and innovations in this quickly growing area. This includes carbon structures, nanoparticles, aerogels and more.

6.5.5 Automation and Process Control

The aim is to deepen the knowledge in the field of feedback control systems. To become acquainted with computer-aided methods of modeling, simulating, and research of process control systems (based on MATLAB and LabVIEW). To show typical solutions to automation in the textile industry.

6.5.6 Garment Technology

Recognize and appreciate the correct combination of basic factors related to garment assembly; develop an understanding of basic garment construction techniques & processes; recognize garment assembly faults and recommend appropriate solutions; develop skills of analysis and evaluation.

6.5.7 Industrial Information Systems

To further extend the knowledge in the field of automation and process control by transferring knowledge of sensors, actuators, signal processing, and, industrial control systems.

6.6 Third semester courses

6.6.1 Application of Technical Textiles

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The main theme of this course is to know the technical applications of textile materials more specifically in filtration textiles, Protective Textiles, Medical textiles, Civil Engineering Applications, Industrial Garment Applications, Transportation Applications (automotive, aviation).

6.6.2 Technical Textile Manufacturing Technology

The focus is given to the basic processes through which technical textiles are produced including information about man-made textile fibers and their manufacturing techniques, synthetic fibers, and their manufacturing techniques and the focus is also given on achieving the goal of getting detailed information high-performance fibers.

6.6.3 Innovative Methods for the Product Development Process for Garments and Technical Applications in the Ready-Made Industry

The objective of this course is to get knowledge about product development tools and software like CAD/CAM in the apparel industry and three-dimensional designs for fabrics to make technical textiles. Furthermore, the behavior of materials used to make technical textiles is studied.

6.6.4 Comfort and Computation of Textiles

The outcome of this course is to extend knowledge in the field of human comfort wearing different kinds of clothing, by knowing comfort in textiles, physiological comfort, thermal comfort, sensorial comfort, ergonomic comfort (what makes fabrics comfortable?) different methods of measuring comfort in humans, laboratory methods of fabrics and clothing assessment, modeling of comfort.

6.6.5 Intelligent Textiles

Obtain an understanding of functional textile materials; obtain knowledge of smart and functional textile materials and structures and their basic materials, to convert classical devices into fiber-based structures is the main objective of this course.

6.6.6 Sustainable Textile Design

To know the sustainable design and manufacturing in a broad context through applications of textiles in the environmental perspective. To know the wastewater treatment, to analyze the typical textile processes and downstream Treatment Systems, and its recycling is among the main goals of this course.

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6.6.7 Management, Logistics, and Distribution

The core objective of this course is to present different aspects related to supply chain, logistics, and distribution of products. Furthermore, knowledge of Computer Integrated Manufacturing (CIM), Production Management Systems (PMS), Just in Time (JIT) is also among the main goals of this course.

6.6.8 Scientific Thinking

Scientific thinking and acting are crucial for conducting sound research. Critical thinking in a broad sense is one of the strategic objectives of Ghent University. However, high intelligence and academic education are not enough to prevent irrational thinking. Critical thinking is therefore not natural, but must be learned. Yet, critical thinking is more important today than ever to be able to evaluate the reliability in the oversupply of information and to use scientifically sound methods for this. The multicultural society and globalization also increase the need for critical thinking. How can we critically assess our cultural traditions (beliefs, attitudes, customs) and those of others, and how do we deal with cultural diversity? Engineers have acquired a thoroughly scientific basis, but they too are not free from irrational thinking. This course focuses primarily on international groups of engineering students.

6.7 Elective Courses

Apart from the obligatory courses, 3 credit units are open for elective courses. This is specifically aimed at doing an internship or a specialist course if no internship is done.

6.7.1 Internship

See Deliverable 1.3 for an overview of internship at UGent. Both a Belgian and an international setting are allowed.

The goal is to bring the student into contact with the actual industrial, scientific or social environment where the knowledge acquired during the study will be practically applied.

6.7.2 Specialist course

This course is an in-depth addition to one of the other textile engineering courses, in the field of advanced materials, processes or applications of textile materials. The course aims at a critical analysis of theoretical and experimental knowledge and its creative application.

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This course targets a specific textile subject in line with the programme contents (textile materials, processes and applications) offered by a local expert from the hosting university or from one of the AUTEX members. Examples of such topics are: functional finishing, digital technologies in textiles, hybrid textile structures, standardisation and testing.

6.8 Master's Dissertation

The master's programme is completed with the master's dissertation. The master's dissertation is a project in which the student employs his/her ability to analyse and synthesize information, to independently solve problems at an academic level, or to create art. The result reflects the student's general critical and reflective attitude or his/her disposition towards research. The master's dissertation contributes to the realization of a number of desired programme competences

The master's dissertation is a research project, consisting of the execution of a subject (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…) and a presentation with oral defense. One interim report is also expected. While executing the master's dissertation, the student will regularly meet with his/her supervisors. The subject and contents of the master's dissertation can be determined in two ways.

Supervisors can determine and announce possible subjects via the electronic platform. Possible subjects include the definition of the problem and goal. Students can choose such a subject. Students are also free to propose their own master's dissertation's subject, by formulating a subject and finding a supervisor. Either way, the subject of the master's dissertation is always only determined after joint consultation between the student and the dissertation supervisor(s). The supervisor will concretize the desired final competence.

At the start of the master's dissertation, a basic knowledge is expected in the field of research. The student has an advanced knowledge of and an insight into the field in general, and in the specialization in particular. Next to this, the student can independently look up and process information, can formulate research questions, can report and discuss on scientific findings etc.

7. Master of Science in Materials Engineering – Major Polymers and Fibre Structures

The Master of Science in Sustainable Materials Engineering - **Major Polymers and Fibre Structures** at UGent, aims at the study of the properties, the production and the application of fibrous materials on a natural base as well as on a synthetic one. Much attention is paid to the study of

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polymers. Furthermore composite materials are studied as a consequence of their structure consisting of a polymer and a fibrous material. The specialisation in textiles focusses on the properties and production of natural and synthetic textile raw materials (the fibres), processing these materials into semi-finished products (yarns, fabrics, non-wovens, …) and applying finishing techniques for specific applications (high-quality fabrics, interior textiles, technical textiles, …). Textile fibres are dealt with and the different production techniques for yarns, fabrics, non-wovens, carpets, … are explained. Further, the technology, the behaviour of fibres and yarns during processing and the fundamental properties of the structures are highlighted. Physical or chemical finishing techniques can provide additional properties (added value). The theory of colour, colour formation and perception and the treatment of different colour types including their application are described. As such, textile materials and processes are explained and special attention is paid to the development of products with specific functionalities (flame retardant, crease resistant, antibacterial, …). Statistical methods are described allowing to define an optimum set-up and verification of results.

This master is open to bachelors in Engineering, while a preparatory course is required for most bachelors in Science (Physics, Chemistry, etc.) and bachelors in Industrial Sciences.

The other Major in Materials Engineering is in Metal Science and Engineering, which we don't consider further.

7.1 Complete programme

The complete program is given in the following table

Table 2. Structure of the ECTS credits

	ECTS	Semester
General courses		
Fracture and Deformation Behaviour of Materials	6	1
Structure and Dynamics of Polymers	6	1
Polymer Processing	6	2
Micro-analysis and Structure Determination in Materials Science	6	1
Materials Science Thermodynamics	6	1
Composites	6	3

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Major Polymers and Fibre Structures		
Fibre Materials	6	1
Process Technology in Textiles	6	2
Chemical and Physical Textile Technology	6	2
Colour and its Applications in Textiles	6	2
Analysis of Products and Processes	6	3
Functional Textile Materials	6	4
Elective Courses (24 Credits to select)		
Quantum Mechanics I	6	2/4
Quantum Mechanics II	6	1/3
Computational Materials Physics	6	1/3
Physical Materials Science	6	2/4
Master Dissertation		
Master's Dissertation	24	COMPULSORY

7.2 Information about general courses

Besides a thorough formation in materials science, the education also comprises more general basic courses to provide the student a clear image about his (her) future career. By means of the introduction of a certain amount of elective courses, the student can give his (her) education a more personal touch.

Almost all following courses are 6 credit courses

7.2.1 Fracture and Deformation Behaviour of Materials

Teaching of basic knowledge and insight in the mechanical response of technically important materials on external loading or forming operations. Elastic, microplastic and plastic phenomena are treated. Students will not only acquire fundamental knowledge on the basic deformation and failure mechanisms, but also the basic instruments are taught which are at the disposal of the materials science engineer for controlling the mechanical response. In addition to the above, basic forming operations are discussed.

7.2.2 Structure and Dynamics of Polymers

Detailed study of the fundamentals of the structure and the (thermo)dynamics of polymers and polymer solutions (including melts), considering different length scales and covering both detailed

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experimental characterization and modelling tools. With respect to the study of the structure of polymers, aspects such as semi-crystallinity, crystalline state, melting behaviour, orientation, and structure-property relations are discussed. With respect to the study of the (thermo)dynamics of polymers, aspects such as segment/solvent interactions, diffusivity and basic behaviour under flow conditions (melt and solution) are discussed. Important aspects are also highlighted by case studies.

7.2.3 Polymer Processing

The combined application of the basic concepts of polymer physics, polymer chemistry, material science, mechanical engineering, structure and dynamics of polymers, and transport phenomena with as aim the fundamental understanding, design, and optimization of the major industrial polymer processing techniques. Attention is focused on both operational and simulation characteristics on the one hand and sustainability and recycling on the other hand. Case studies are included per polymer processing technique considered.

7.2.4 Micro-analysis and Structure Determination in Materials Science

The course aims to give the student an insight in the techniques for the micro-analysis and structural analysis of modern engineering materials. Both theoretical principles and practical applications together with the specific sample preparations techniques are given an in-depth review. Fundamentals of particle beams, beam-sample interactions and beam optics are discussed. The architecture of specific equipment is discussed in detail.

7.2.5 Materials Science Thermodynamics

This course deals with the fundamental aspects concerning the thermodynamics of metallurgical processes (pyro, hydro and electrometallurgy) with an emphasis on phase diagrams (pyro and hydro), Ellingham diagrams, Pourbaix diagrams, activities, nonidealities and Butler-Volmer kinetics of electrochemical processes (Evans diagrams) and their applications. The course forms the basis for later courses on extractive pyro-, hydro- and electrometallurgy.

7.2.6 Composites

This course deals with an introduction to the technology and the mechanics of fibre reinforced materials. In general, products made of those materials are quite different from traditional isotropic materials, such as metals and plastics. The course treats on the technology, the basic mechanics, and some specific aspects of fibre reinforced materials. As this course is also meant

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for other disciplines than pure materials science, it mainly focuses on the mostly used fibre reinforced plastics.

7.3 General courses (Major Polymers and Fiber structures)

Besides a thorough formation in materials science, education also comprises more general basic courses to provide the student with a clear image of his (her) future career. Through the introduction of a certain amount of elective courses, the student can give his (her) education a more personal touch.

7.3.1 Fiber materials

The goal is to make the students familiar with the main textile fibers as a basis for textile materials. Natural and synthetic textile fibers are dealt with, as well as their production, properties, and their uses.

7.3.2 Process technology in textiles

The course unit deals with technological aspects of production processes to convert raw material, i.e. fibers, into one-, two- or three-dimensional textile structures, namely yarns, flat materials, and materials with a certain thickness. This includes preparations for spinning, spinning itself, weaving, knitting, production of non-wovens, tufting.

7.3.3 Chemical and physical textile technology

The aim is to make the students familiar with chemical and physical treatments (finishing treatments), which have as a result that the textile material obtains some specific properties leading to a higher added value.

7.3.4 Color and its applications in textiles

The aim is to make the students familiar with the main aspects of how color is perceived and how color can be quantified. Further, theoretical, practical, and technological aspects related to the application of color are dealt with for different textile materials.

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7.3.5 Analysis of products and processes

The course unit aims to teach the students how a maximum of reliable information can be obtained about a process or a product with a minimum of effort. An item deals with quality systems. Statistics is the tool learned and applied for this.

7.3.6 Functional textile materials

The aim is to provide a basic understanding of how textile structures function; the course also allows the students to become familiar with the latest developments in the field of intelligent materials. In this framework, guest speakers will be invited.

7.4 Elective courses (Major Polymers and Fiber structures)

7.4.1 Quantum mechanics I

This course can be considered as an introduction to the traditional "Modern Physics" course. A short treatment of Einstein's special theory of relativity is given. Special attention goes to the experimental basis of Quantum Physics, emphasizing the limits of classical physics and the introduction of Quantum Mechanics. The postulates are introduced among which the time-dependent Schrödinger Equation. In this lecture, applications are restricted to one-dimensional problems. More formal mathematical aspects of quantum theory are discussed as an introduction to the follow-up course "Quantum Mechanics II".

7.4.2 Quantum mechanics II

Basic concepts and advanced quantum mechanics. Basic knowledge of quantum mechanics is required (as the concept of one-dimensional Schrödinger equation). It is the final intention to treat the (one-body) perturbation theory in great detail. The lectures are expected to give a founded basis for more specialized issues such as semi-conducting physics, atomic and molecular physics, subatomic physics, many-body problems, molecular modeling, etc.

7.4.3 Computational materials physics

All observable properties of materials are ultimately governed by interactions between their nuclei and electrons. Those interactions are described by the laws of quantum physics. The corresponding mathematical equations that have to be solved, are known for a long time. Thanks

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to efficient algorithms and ever-faster computers, those equations can be effectively solved for an increasing number of situations. In this way, the observable properties of materials can be explained directly from quantum physics. In the same way, properties that are not yet measured can be predicted. Through hands-on computer exercises, we will learn in the course how to compute many different properties of solids from first principles. Case studies will offer an overview of the computational tools that are available for materials scientists and condensed matter physicists to understand materials at the atomic level -- and even to design them.

7.4.4 Physical materials science

To provide basic knowledge and insight in the principles of materials science, discussion of the microstructure of polycrystalline materials, and the solid-state transformations by which the microstructures are formed and controlled. Scientific knowledge of the mechanisms that produce different microstructures and the influence thereof on properties.

7.5 Master's Dissertation

The master's programme is completed with the master's dissertation. The master's dissertation is a project in which the student employs his/her ability to analyse and synthesize information, to independently solve problems at an academic level, or to create art. The result reflects the student's general critical and reflective attitude or his/her disposition towards research. The master's dissertation contributes to the realization of a number of desired programme competences.

The master's dissertation is a research project, consisting of the execution of a subject (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…) and a presentation with oral defense. One interim report is also expected. While executing the master's dissertation, the student will regularly meet with his/her supervisors. The subject and contents of the master's dissertation can be determined in two ways.

Supervisors can determine and announce possible subjects via the electronic platform. Possible subjects include the definition of the problem and goal. Students can choose such a subject. Students are also free to propose their own master's dissertation's subject, by formulating a subject and finding a supervisor. Either way, the subject of the master's dissertation is always only determined after joint consultation between the student and the dissertation supervisor(s). The supervisor will concretize the desired final competence.

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At the start of the master's dissertation, a basic knowledge is expected in the field of research. The student has an advanced knowledge of and an insight into the field in general, and in the specialization in particular. Next to this, the student can independently look up and process information, can formulate research questions, can report and discuss on scientific findings etc.

8. Conclusion

Students in Belgium have two paths towards becoming a textile engineer. They can follow a broad Materials Engineering master, with specific major in polymers and fiber structures. This results in a big theoretical foundation applicable in the textile industry, with a focus on polymers, and supported by research groups in UGent in polymers, smart textiles, electrospinning, composites, artificial turf and more.

For a more focused textile education, the International Textile Engineering master is available, with a focus on the full range of textile applications, as well as a closer integration with textile industry.

In this way, the full needs of the textile industry in Europe can be covered. It must be noted that apart from the UGent academic majors, there are also University Colleges in Belgium offering professional bachelors in Textiles, which, as they are not academic, have not been covered in this part.

9. Introduction - SPAIN

In this work, an analysis of the textile study plans of Spain will be carried out, focusing in depth on Technical Textiles and Smart Textiles. These training plans are intended to train professionals in the textile sector, especially in the field of technical and intelligent textiles applied in various sectors such as medical, industrial, construction, etc.

The need for this type of professionals is increasing, due to the current demand for technical textiles experts capable of maximizing the potential of textiles. The proper combination of this type of products and its continuous improvement results in high-performance materials and products with amazing properties, multiplying their applications.

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For this reason, universities and teaching organizations want to improve their study systems, in order to train the best professionals, offering them adequate content that will serve as the basis for their future work.

The offer of this type of available studies is mainly focused on two unique universities within the Spanish territory, the Universitat Politècnica de València and the Universitat Politècnica de Catalunya.

10. Textile Bachelor's studies

10.1 Universitat Politècnica de València (UPV)

The Universitat Politècnica de València is a public institution that offers a high technological education in many fields like engineering, design, and architecture. The university is made up of more than 50 bachelor's degrees that are distributed in 3 campus, 2 of them in the province of Valencia and the last one in the province of Alicante, in the city of Alcoi.

This institution has always had positive evaluations in technical education, being awarded many times and positioning itself as one of the best polytechnics nationally and internationally. Recently, the Shanghai Ranking has reaffirmed the UPV as the best Spanish polytechnic university. These good results obtained in recent years make a study of the methodology used be necessary and the university be seen as an example to be followed by other institutions.

The campus of Alcoi, Escola Politècnica Superior d'Alcoi (EPSA), is a small and close institution where 6 degree studies and 2 double degrees are taught. Moreover, the campus has more than 20 investigation structures where the student can improve their knowledge and test them with practical cases. One of these places is the Department of Textile and Paper Engineering (DITEXPA), who is responsible for organizing and developing research and teaching specific to various areas of knowledge, such as Physical Chemistry and Textile and Paper Engineering.

10.1.1 Study plan of the bachelor's degree in Industrial Design Engineering and Product Development

These studies train professionals from a scientific and technical point of view to be able to direct and manage the entire life process of a product from the generation of ideas, through production, manufacture and launch of the product.

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Depending on the campus where the degree is taught, there are two possible itineraries with several specializations. In Alcoi, students can choose between Production and Innovation, Quality and Management, Product Design and Textile and Fashion.

The degree has a duration of 4 years and it contains a total of 240 ECTS credits, which are structured as follows:

Table 3. Structure of the ECTS credits

Basic training	Compulsory	Optional	External practice	TFG	TOTAL
60	120	48	-	12	240

The different subjects that make up the degree are divided into those that make up basic training in the early years, compulsory ones, which must be taken by all students, and optional ones, through which each student can personalize their training.

Table 4. Curriculum of the degree

	ECTS	TYPE
First Semester		
Artistic Drawing*	9	BASIC TRAINING
Computer Science	6	BASIC TRAINING
Mathematics I*	9	BASIC TRAINING
Physics*	9	BASIC TRAINING
Technical Design I	6	BASIC TRAINING
Second Semester		
Aesthetics and History of Design	6	COMPULSORY
Artistic Drawing*	9	BASIC TRAINING
Business Administration	6	BASIC TRAINING
Mathematics I*	9	BASIC TRAINING
Physics*	9	BASIC TRAINING
Third Semester		
Mathematics II	6	BASIC TRAINING

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Materials	6	COMPULSORY
Design Methodology*	9	COMPULSORY
Basic Design and Creativity*	9	COMPULSORY
Creative Aspects for Textile Product Design	6	OPTIONAL
Digital Image Processing	6	OPTIONAL
International cooperation and trade	6	OPTIONAL
Fourth Semester		
Electrical and Electronic Technology	6	COMPULSORY
Aesthetics and History of Design	6	COMPULSORY
Design Workshop I	6	COMPULSORY
Materials II	6	COMPULSORY
Design Methodology*	9	COMPULSORY
Basic Design and Creativity*	9	COMPULSORY
Metrology	6	OPTIONAL
Fifth Semester		
Materials for designing Textile Products	6	OPTIONAL
Advanced Prototypes	6	OPTIONAL
French Language	6	OPTIONAL
German Language I	6	OPTIONAL
New Materials and Surface Finishes	6	OPTIONAL
Mechanics and Theory of Mechanisms	4,5	COMPULSORY
Industrial Processes*	9	COMPULSORY
Computer-aided Design*	9	COMPULSORY
Graphic Design and Communication	6	COMPULSORY
Ergonomics	4,5	COMPULSORY
Sixth Semester		
Strength of Materials	4,5	COMPULSORY
Industrial Processes *	9	COMPULSORY
Computer-aided Design *	9	COMPULSORY
Containers and Packaging	4,5	COMPULSORY
Design Workshop II	6	COMPULSORY
English for Industrial Design B2	6	OPTIONAL
Business management of product development	6	OPTIONAL
Simulation	6	OPTIONAL
Seventh Semester		
Engineering Department	6	COMPULSORY
Marketing and legal aspects	6	COMPULSORY

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Design workshop III	6	COMPULSORY
Product presentation techniques	6	COMPULSORY
Technical aspects of textile product design	6	OPTIONAL
Eighth Semester		
CAD CAM for textile products	6	OPTIONAL
Specification for textile product design	6	OPTIONAL
Textile product design	6	OPTIONAL
Final Project	12	COMPULSORY

**These subjects have a duration of two semesters*

The basic formation is very similar to the other engineer degrees including subjects like physics, mathematics, or technical design. This allows that students achieve a solid and multidisciplinary base, facilitating the exchange between degrees and universities in the first months of teaching.

All textiles teachings are part of the optional credits and are distributed throughout the last 3 years of the degree, taking greater importance in the last semester, when the student can choose the textile itinerary. Although, the student can choose each of them independently of having completed the others, it is recommended to follow the textile itinerary to reach the last specialty subjects with a certain base that allows them to obtain all the knowledge.

The textile curriculum is formed by the next subjects:

Table 5. Textile subjects that form the curriculum

Third Semester		
Creative aspects for textile product design	6	OPTIONAL
Fifth Semester		
Materials for designing textile products	6	OPTIONAL
Seventh Semester		
Technical aspects of textile product design	6	OPTIONAL
Eighth Semester		
CAD CAM for textile products	6	OPTIONAL
Specification for textile product design	6	OPTIONAL
Textile product design	6	OPTIONAL

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Creative Aspects for Textile Product Design

This course has two general objectives, one of them is to show the student the creative possibilities that textile articles allow both traditional textile sectors and new fields of application in different sectors.

On the other hand, it aims to show the means by which textile designers can intervene in the development of articles, such as color, textures, materials, structures, finishes, etc., in order to provide each product with the required characteristics.

The main objective is to encourage student creativity while showing the possibilities offered by textile technology for the development of final textile products or textile products that may be components of other types of products.

Moreover, it wants to transmit to the student the sensitivity in the development of sustainable products.

The subject is structured in the next units:

Table 6. Units of the subject Creative Aspects for Textile Product Design

1.	**INTRODUCTION TO TEXTILES**	
	1.1	Classification of textile fibers
	1.2	Properties of textile fibers
2.	**LINEAR STRUCTURES: YARNS AND BRAIDS**	
	2.1	Classification of linear structures
	2.2	Parameter of linear structures
3.	**LAMELLAR STRUCTURES: WOVEN AND NON-WOVEN FABRICS**	
	3.1	Classification of fabrics
	3.2	Fabric properties
	3.3	Fabric parameters
4.	**COLOUR AND COLORATION**	
	4.1	Processes for applying color to textiles: dyeing and printing
	4.2	Color Measurement

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5.	**FINISHING PROCESSES**	
	5.1	Properties applicable to textiles by means of finishing processes
	5.2	Classification of finishing processes
6.	**TEXTILE ECODESIGN**	
	6.1	Sustainable Fashion
	6.2	Ecological and sustainable processes.
	6.3	Textile Ecolabeling
7.	**APPLICATION OF TEXTILE PRODUCTS**	
	7.1	Conventional textiles.
	7.2	Technical textiles
8.	**APPLICATION OF CREATIVITY TECHNIQUES**	
	8.1	Introduction to creativity techniques
	8.2	Application of creativity techniques for the definition of textile products

Finally, it is desired that the student achieves the following objectives:

- Identify in the context of companies and organizations the rules and regulations necessary for the implementation of projects and other activities
- Determine the economic-financial aspects of projects and other areas of activity.
- Approach the design and development of products with the aesthetic sensitivity characteristic of design and assimilate a historical-social culture typical of industrial design engineering.
- To know the industrial reality and, in particular, concepts of applications of the Design.
- To apply the corresponding regulations.
- Report on innovation, change and improvement of industrial products.
- Transmit relevant information of industrial products using formal, graphic, and symbolic languages in an appropriate way.
- Evaluate and optimize criteria for decision making.

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Materials for Designing Textile Products

Since this subject imparts knowledge about the basic raw materials of the textile process, the fibers, the knowledge acquired in this subject will be applied in subsequent subjects and the basis of knowledge of the raw materials you will use in the performance of your professional life.

This subject allows students to train in:

- Knowledge of the properties and parameters of the fibers.
- Measurement, characterization, classification and applications of fibers according to their physical and chemical properties.
- Study of the different raw materials used in the textile sector. Obtaining, properties, commercial varieties, textile parameters, characteristic aspects, applications, productions, and consumptions.
- Study of fibers for non-conventional uses. Obtaining, properties, commercial varieties, textile parameters, characteristic aspects, applications, productions, and consumptions.
- Coloring matter. Dyeing and fiber coloration families.

The subject is divided into three didactic units, a first part is generic and deals with the properties of fibers. Another part of the course focuses on the study of certain specific fibers and garment composition.

Table 7. Units of the subject Materials for Designing Textile Products

1. INTRODUCTION. GENERAL CHARACTERISTICS OF TEXTILE FIBRES AND THEIR DETERMINATION. PARAMETRY.	
1.1	History and evolution of fibers. Classification
1.2	Introduction to fiber-forming polymers. Chemical spinning
1.3	Geometric Properties of Textile Fibers
1.4	Physical Properties of Textile Fibers
1.5	Chemical Properties of Textile Fibers
2. DESCRIPTIVE STUDY OF TEXTILE FIBRES	
2.1.	Natural textile fibers.
2.2.	Chemical textile fibers of natural polymer.
2.3.	Synthetic polymer chemical textile fibers.
2.4.	Textile fibers of various origin

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3.	**DYESTUFFS AND AUXILIARIES**
3.1	Textile Fiber Coloring
3.2	Auxiliary products
3.3.	Dyes and pigments

Finally, it is desired that the student achieves the following objectives:

- Use the necessary tools and instruments for the observation and solution of engineering and architectural problems.
- To apply the corresponding regulations.
- To design and direct projects in the field of industrial design engineering, adopting criteria of environmental sustainability, critical vision, and creativity.

Technical Aspects of Textile Product Design

The objective of the course is to show the student the different possibilities that the textile sector must achieve that the manufactured products can acquire demands that its later use requires. These technologies may be obtained, in addition to the use of textiles, by spinning processes, obtaining different laminar structures and the technification of the textile article by sizing and finishing processes.

Table 8. Units of the subject Technical Aspects of Textile Product Design

1.	**TECNIFICATION OF TEXTILE PRODUCTS BY MEANS OF LINEAR STRUCTURES**
2.	**TECNIFICATION OF TEXTILE PRODUCTS BY MEANS OF LAMINAR STRUCTURES**
2.1.	Non-woven fabrics
2.2.	Woven fabrics
2.3.	Knitted fabrics
3.	**TECNIFICATION OF TEXTILE PRODUCTS BY MEANS OF SIZING AND FINISHING**
3.1	Sizing Processes
3.2	Finishing processes

Finally, it is desired that the student achieves the following objectives:

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- To know the industrial reality and in particular, concepts of applications of the Design.
- To apply the corresponding regulations.

CAD CAM for Textile Products

This subject is an introduction to analogue and digital printing methods with the concept of ornamental design of fabrics by different techniques and the generation of stamped designs using CAD/CAM design programs.

Obtaining prototypes of the designs elaborated by means of the technique of digital stamping or designing of environments with the incorporation of textiles is another of the topics on which the subject is focused, making an introduction to 3D environment simulation.

Moreover, the student will also acquire the knowledge of the concepts of referral and chopping in the weaving shed and the knowledge of woven structures by means of openwork.

Finally, they will be able to generate fretwork fabric designs using CAD/CAM design programs and to obtain prototypes of the designs elaborated by means of jacquard weaving.

Table 9. Units of the subject CAD CAM for Textile Products

1.	**CREATION OF ORNAMENTAL DESIGNS ON FABRICS**
1.1	Fabric design and rapport
2.	**STAMPING**
2.1.	Introduction to textile printing
2.2.	Design of stamped products using CAD systems
2.3.	Production of stamped prototypes using CAM systems
3.	**ROOM SIMULATION**
3.1	Application of textile textures to simulate 3D environments
4.	**WEAVING**
4.1	Structures for shed weaving

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4.2	Obtaining of tissue prototypes through CAM systems
4.3	Design of fretwork fabrics using CAD systems

Finally, it is desired that the student achieves the following objectives:

- Identify in the context of companies and organizations the rules and regulations necessary for the implementation of projects and other activities
- Evaluate and optimize criteria for decision making.

Specification for Textile Product Design

Every textile product, whatever its use, must comply with a series of specifications that make it suitable for its application.

The contents of the course are summarized in the knowledge of the characteristics that textile products present and the methodology for obtaining them.

The ability to interpret regulations governing test methodologies will also be developed.

In the practical aspect, the characterization tests of textile products, for which capacity is presented, will be carried out in the laboratories themselves.

Table 10. Units of the subject Specification for Textile Products Design

1.	**METHODOLOGY FOR THE CHARACTERIZATION OF A TEXTILE PRODUCT**
1.1	Standardization and industrial quality
1.2	Technical data sheet of a textile product
2.	**CHARACTERISTICS OF A TEXTILE FABRIC OR GARMENT**
2.1	Structural characteristics
2.2	Mechanical behavior characteristics
2.3	Characteristics of behavior to fluids
2.4	Characteristics of behavior to use
2.5	Behavioral characteristics of conservation treatments
2.6	Fire behavior characteristics

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3.	LEGISLATION AND STANDARDS APPLICABLE TO TEXTILE PRODUCTS
3.1	Legislation for composition labelling of textile garments
3.2	Regulations for the conservation labelling of textile garments
3.3	Current legislation regarding import restrictions

Finally, it is desired that the student achieves the following objectives:

- Identify in the context of companies and organizations the rules and regulations necessary for the implementation of projects and other activities
- Integrate basic scientific knowledge.
- Evaluate and optimize criteria for decision making.

Textile Product Design

The general objective of this course is the study of the different possibilities of obtaining textile articles from raw materials (fibers) to the obtaining of the ready-made product.

The student will carry out the integral process of developing a textile product located in one of the specified sectors. Starting from the students' previous knowledge of the basic stages of the different textile processes, the aim is for the student to be able to select the necessary stages and the optimum combination of them in order to meet the requirements involved in the development of the different types of textile products.

Table 11. Units of the subject Textile Product Design

1.	INTRODUCTION TO TEXTILE PRODUCT DEVELOPMENT
1.1	Considerations for the development of textile products
1.2	Application markets for textiles
2.	**DESIGN AND DEVELOPMENT OF A TEXTILE PRODUCT**
2.1	Product Definition
2.2	Presentation of the product to the market
2.3	Study of the preparation of the product
2.4	Study of the finishes to be applied to the product

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2.5	Study of the characteristics and processes for obtaining the component fabrics of the product
2.6	Study of possible fibrous materials and yarns applicable to the product

Finally, it is desired that the student achieves the following objectives:

- Identify in the context of companies and organizations the rules and regulations necessary for the implementation of projects and other activities
- Evaluate and optimize criteria for decision making.

10.2 Universitat Politècnica de Catalunya (UPC)

The Universitat Politècnica de Catalunya · BarcelonaTech is also a public institution of research and higher education in the fields of engineering, architecture, sciences, and technology, and one of the leading technical universities in Europe. Every year, the university welcomes more than 6,000 bachelor students which are distributed in 73 bachelor's degrees.

The UPC is not only present in Barcelona, but also has various campuses scattered around the city in several nearby towns: Castelldefels, Manresa, Sant Cugat del Vallès, Terrassa, and Vilanova i la Geltrú.

Terrassa School of Industrial, Aerospace and Audiovisual Engineering (ESEIAAT) includes 17 bachelor's degrees related to the engineering being one of these, the bachelor's degree in Textile Technology and Design.

10.2.1Study plan of the bachelor's degree in Textile Technology and Design

On this bachelor's degree, students are built on the common industrial engineering component and come to understand the fundamentals of textile materials and processes, the integral development of textile products and industrial garment making, linear textile structures and non-woven fabrics (technical and smart fabrics), processing and finishing operations, biopolymers, and global textile business logistics and management.

Finally, when they finish their studies, they are able of understand, select and use the correct textile products and materials, including technical and smart fabrics; designing, optimizing and developing technologies related to textile products and processes; and supervising and managing textile companies.

The degree has a duration of 4 years with 240 ECTS credits including the bachelor's thesis, being one credit equivalent to a study load of 25-30 hours.

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Table 12. Structure of the ECTS credits

Basic training	Compulsory	Optional	External practice	TFG	TOTAL
60	126	30	-	24	240

The curriculum is divided into eight semesters, 2 per year, and it includes both compulsory and optional subjects.

Table 13. Curriculum of the bachelor's degree

	ECTS	COMPULSORY/ OPTIONAL
First Semester		
Chemistry	6	C
Environmental Technologies and Sustainability	6	C
Graphic Expression in Engineering	6	C
Mathematical Methods I	6	C
Physics I	6	C
Second Semester		
Economics and Business Administration	6	C
Foundations of Computing	6	C
Materials Science and Technology	6	C
Mathematical Methods II	6	C
Physics II	6	C
Third Semester		
Electric Systems	6	C
Fluid Mechanics	6	C
Mathematical Methods III	6	C
Mechanical Systems	6	C
Production Organization	6	C
Fourth Semester		
Electronic Systems	6	C
Industrial Automation and Control	6	C

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Materials for Textile Design	6	C
Probability and Statistics	6	C
Thermal Engineering	6	C
Uav Research & Development	3	O
Uav Research & Development Project	3	O
Fifth Semester		
Bleaching and Dyeing Design Colorimetry	6	C
Coloring Agents and Auxiliary Materials	6	C
Design of Laminar Mesh Structures	6	C
Design of Laminar Net Structures	6	C
Design of Non-Woven Linear and Laminar Structures	6	C
Sixth Semester		
Advanced Programming Oriented Towards Goals	3	O
Air Pollution and Treatment Technologies	6	O
Characterization Techniques for Metallic Alloys	3	O
Clothesmaking with Textile Structures	6	C
Creative Lab	6	O
Creative Programming with Processing	3	O
Critical Thinking for 3D Printing	6	O
Decision Criteria - Engineer as Employee or Engineer as Entrepreneur	3	O
Design of Dyeing, Printing and Coating Processes	6	C
Dressing and Finishing Processes	6	C
Electromobility and Electrical Aircraft Systems	3	O
Energy Efficiency Systems	3	O
Energy Storage and Conversion Application	3	O
Experimental Design	3	O
Fundamentals of Robotics	3	O
Highly Automated Production Systems	3	O
Information and Communication Technology	3	O
Integral Development of Textile Products	6	C
Introduction to Forensic Expert for Technique Dispute Resolution	3	O
Introduction to Object-Oriented Programming	3	O
Introduction to Reverse Engineering	3	O
Mathematical Models in Engineering	3	O
Mathematics and Computing Engineering	3	O
Mobile Programming	6	O
Real-Time Programming and Database Systems	3	O
Robotics and Automation	3	O

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Safety Robotics and Automation for Industry 4.0	3	O
Surface Chemistry for Industrial Applications Design	3	O
Technology, Society and Globalization: the Sustainability Challenge in the XX Century	6	O
Uav Generative Design	6	O
Web Applications	3	O
Written Academic Skills for Engineering	3	O
Seventh semester		
Advanced Programming	6	O
Evaluation of Tissue Quality	6	O
Initiation to Paper and Graphic Industrial Technologies	6	O
Innovation Project Management	6	C
Internship	12	O
Jacquard Design	6	O
Modelisation, Complexity and Sustainability	6	O
Polymers in Engineering	6	O
Programming of Mobiles Android	6	O
Project Oriented Methodology	6	C
Treatment and Reuse of Blackwater	6	O
Eighth Semester		
Bachelor's Thesis	24	Project
Basic Robotics	6	O
Numerical Methods for Engineers	6	O
Photonics. Optics Applied to Engineering	6	O
Waste Management and Treatment	6	O

In the first and second year of the degree, the student will achieve basic engineering knowledge thanks to the basic formation subjects that are compulsory. The following semesters are focused on textile teachings with a lot of subjects, compulsory and optional, that will allow the student to choose the best itinerary.

Next, the main subjects related to textile education within the degree have been analyzed, since they are considered essential for textile students.

Materials for Textile Design

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This subject contributes with the knowledge of the chemical compound behaviour for the for the textile ennoblement and the knowledge of materials and their application in the textile industry.

Table 14. Units of the subject Materials for Textile Design

1.	**TEXTILE FIBERS. PROPERTIES RELATED TO FIBRE GEOMETRY. FIBRE ANALYSIS**
1.1	Textile fibers. Definition, classification and general concepts.
1.2	Fiber length. Characterization and significance to textile processes and design.
1.3	Crimping. Characterization and significance to textile processes and design.
1.4	Fineness. Characterization and significance to textile processes and design.
1.5	Cross-sectional shape. Characterization and significance to textile processes and design.
2.	**PROPERTIES RELATED TO THE NATURE OF FIBERS**
2.1	Fiber density. Characterization and significance to textile processes and design.
2.2	Mechanical properties of fibers. Characterization and significance to textile processes and design.
2.3	Technical properties of fibers. Characterization and significance to textile processes and design.
2.4	Sorption properties of fibers. Conditioning. Characterization and significance to textile processes and design.
2.5	Optical properties of fibers. Characterization and significance to textile processes and design.
2.6	Electrical properties of fibers. Characterization and significance to textile processes and design.
3.	**PROPERTIES RELATED TO THE NATURE OF FIBERS**
3.1	Structure and properties of cellulose natural fibers.
3.2	Structure and properties of wool, silk and the main types of piles.
3.3	Identification of natural fibers.
4.	**CHEMICAL FIBERS. PRODUCTION, PROPERTIES, AND IDENTIFICATION. RELATIONSHIP TO TEXTILE DESIGN**
4.1	Polymerization reactions and spinning processes for chemical fibers.
4.2	Relationship between structure and properties in chemical fibers.
4.3	Identification of chemical fibers.

Finally, it is desired that the student achieves the following objectives:

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- Knowledge of the science, the physical and chemical technology, and properties of the materials textile amenable to spinning and weaving.
- To be able to design any type of fabric of analogous characteristics to which habitually they are attributed to conventional fabric with the typical properties of conventional ones.
- Capacity to know, understand and be able to select textile materials as a function of the specifications of the target product and a predetermined design.
- To know, understand and be able to use available equipment and techniques for the fiber analysis of textile materials with a view to ensuring appropriate use.
- To understand textile material degradation and dry interaction with the environment with a view to its avoidance or minimization.

Integral Development of Textile Products

Table 15. Units of the subject Integral Development of Textile Products

1.	**FUNDAMENTALS OF TEXTILE PRODUCTS DESIGN**
1.1	Basics concepts of textile product design.
1.2	Specifications analysis in textile products.
1.3	Fiber and yarn selection criteria for projecting the main fabric types.
1.4	Design stages for a fashion good. 1.4.1 Basic design and fashion item. 1.4.2 Inspiration sources and trends. 1.4.3 Preparation sequence for a collection.
1.5	Use of design fundamentals to develop an integral project for a specific item.
2.	**PROJECTION OF FANCY AND SPECIAL EFFECTS YARNS**
2.1	Fancy effects obtained in the spinning process.
2.2	Production of the main types of fancy yarns with twisters and special machines.
2.3	Conceptual and formal considerations of yarns produced by non-conventional spinning systems.
2.4	Design of various types of special yarns for technical fabrics and non-textile uses.
2.5	Design of a specific yarn to be used in the integral project.
3.	**COMPUTER AIDED DESIGN OF WOVEN FABRICS**

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3.1 Fundamental concepts and stages for development of collections of fabrics.
3.2 Fundamental criteria for the computer assisted projection of yarns and fabrics.
3.3 Description of the textile CAD tools.
3.4 Capabilities and limitations of CAD tools.
3.5 Practical computer-assisted development of a collection of fabrics.
3.6 Use of CAD for the integral design project.
4. PROJECTION OF COLOURS FOR DYEING AND PRINTING. DESIGN OF FINISHES AND FINISHING EFFECTS
4.1 Design of coloring effects in mixtures of fibers, yarns and fabrics obtained by sustainable dyeing processes.
4.2 Fashion effects by printing processes with a low environmental impact.
4.3 Incorporation of products of finishes and finishing processes with a high value-added.
4.4 Critical analysis of the whole production process for a textile product.
4.5 Perspective axes for the design of new textiles with enhanced functionalities.

Finally, it is desired that the student achieves the following objectives:

- To acquire the foundations and techniques for the textile design of yarns, fabrics, garments, household textiles and technical fabrics.
- To develop the ability to use the previous techniques to solve practical problems by combining a designer's creativity and an engineer's scientific rigor.
- To develop the specific and transversal skills associated to the academic work.

Innovation Project Management

This subject pretends to train students to participate in the planning of business strategies based on product innovation and textile processes, improving the competitiveness of the textile industry in today's environment of global economy and delocalized production.

It provides the student with the skills and knowledge necessary to create the framework that allows innovation in the company and to develop and apply the innovative ideas that are generated.

Table 16. Units of the subject Innovation Project Management

1. THE INNOVATION CULTURE
1.1 What is innovation?

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1.2	Why we should be innovate?
1.3	Barriers to innovation
2.	**KINDS OF INNOVATION**
2.1	Planning vs emerging
2.2	Incremental vs radical
2.3	According to nature
3.	**MANAGEMENT TOOLS AND THEIR APPLICATION IN TEXTILE INDUSTRY**
3.1	Process map
3.2	DAFO
3.3	CANVAS
3.4	Kaizen
3.5	Brain storming
3.6	Ishikawa diagram
3.7	Six thinking hats
3.8	Six Sigma

Finally, it is desired that the student achieves the following objectives:

- Analyze, disseminate, and implement innovations in textile organizations.
- Know the key aspects for implementation of innovation management systems.
- Optimize processes and estimate economical resources need for supporting innovation activities.

Polymers in Engineering

This subject contributes with the knowledge of the science principles, technology, and materials. Understanding the relation between the microstructure, synthesis or processing and properties of these materials.

Table 17. Units of the subject Polymers in Engineering

UNITS	
1.	Introduction to polymers
2.	Polymer synthesis

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3.	Microstructure morphology and properties
4.	Mechanical properties
5.	Functional properties
6.	Introduction to the main polymer transformation processes
7.	Polymer blends
8.	Biopolymers and fibers
9.	Characterization of polymers
10.	Composite Materials
11.	Introduction to the selection criteria of polymeric materials

Finally, it is desired that the student achieves the following objectives:

- Know in depth the science of polymers.
- Analyze the properties of polymers, and how they vary depending on their structure.
- Being able to analyze and know any type of polymer.

10.3 Conclusions - Textile Bachelor's Studies

Textile degree studies are very scarce and, it can be said, that in Spain there is only one degree that directly covers this type of content, the UPC degree. This include some technical textile subjects like Materials for Textile Design or Polymers in Engineering, but most are basic or conventional textile subjects that want to make the students have enough tools to face any textile challenge, without going too deep into technical applications.

In the case of the UPV degree, it only has a few technical textile subjects, Technical Aspects of Textile Product Design and Materials for the Textile Designing, since they are part of a specialization within the degree.

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11. Textile Master's studies

11.1 Universitat Politècnica de València

In addition to the offer of degrees available to the university, it also has a series of official master's degrees that allow students to continue and expand their knowledge, while defining their professional career and preparing for both job opportunities and continue with doctoral studies.

After the Industrial Design Engineering and Product Development degree, students can continue with the master's degree in Textile Engineering. Three reference centres in the sector collaborate in the development of the Master: the UPV, the Textile Technological Institute (AITEX) and the Textile Association of the Valencian Community (ATEVAL). The available infrastructures and the strong relationship with the productive environment that these organizations provide allow us to successfully tackle the proposed training.

11.1.1Study plan of the master's degree in Textile Engineering

The master's degree has a duration of three semesters and 90 ECTS credits that are distributed as follows.

Table 18. Structure of the ECTS credits

Compulsory	Optional	External practice	TFG	TOTAL
60	18	-	12	90

Table 19. Curriculum of the master's degree

	ECTS	COMPULSORY/ OPTIONAL
First Semester		
Innovative aspects in textile fibres and spinning	4,5	C
Colour and Colouring of Textile Materials	6	C
Instrumental techniques applied to textile industry	4,5	C
Advanced Shed Structures	4,5	C
Knitting Structures and Clothing Processes	4,5	C

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Manufacturing Processes of Linear and Non-Woven Laminar Structures	6	C
Second Semester		
Chemical and Mechanical Finishing	6	C
Textile Products Markets and Technical Requirements	4,5	C
Textile Material Characterization	4,5	C
Smart Textiles	6	C
Design of Sustainable Textile Products	4,5	C
Textile Technologies for Composite Materials. Bio and Green-Comp.	4,5	C
Third Semester		
Creating technology-based textile companies	4,5	O
New Polymeric Materials in Textile Application	4,5	O
Technological surveillance and Intellectual Property	4,5	O
Tools for Data Processing in Textile Engineering	4,5	O
Characterization and Primary Treatments of IT Water	4,5	O
Conductive Polymers Applied to Textile Materials	4,5	O
Advanced Textile Industry Water Treatments	4,5	O
Biotechnology in the Textile Sector	4,5	O
Internationalization Strategies for Textile Companies	4,5	O
Digital Design of Openwork Fabrics using Jacquard Technology	4,5	O
Management and Organization of R&D Projects	4,5	O
Global Logistics for the Textile Industry	4,5	O
Occupational Risk Prevention in the Textile Industry	4,5	O
Final Project	12	C

New Polymeric Materials in Textile Application

The course focuses on the study of the electrochemical synthesis of polymers, as well as their electrochemical and spectroscopic characterization. The ultimate aim is to study the development and preparation of conductive polymers on textile materials. The competences and skills acquired during the course can allow the student to deepen in aspects of high scientific interest in the field of polymers with applications of high technological value.

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Table 20. Units of the subject New Polymeric Materials in Textile Application

1.	**INTRODUCTION**
1.1	Chronological review
1.2	Conductive substrates and polymers
1.3	Studies and works in bibliography
1.4	Types of polymerization
1.5	Instrumental techniques
1.6	Research groups
1.7	Publications
1.8	Future research
1.9	Synthesis of polypyrrol-polyoxometalate on polyester yarns and weaving of conductive fabrics
2.	**CONDUCTIVE POLYMERS APPLIED TO TEXTILES**
2.1	Methods of synthesis
2.2	Influence of the dopant
2.3	Influence of substrate
2.4	Textile substrate pre-treatments
2.5	Characteristics of the oxidant
2.6	Effect of temperature
2.7	Effect of the bases
2.8	Analysis and techniques used
2.9	Prototypes of conductive textiles
3.	**ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY APPLIED TO TEXTILES**
3.1	Fundamentals
3.2	Application
3.3	Application to the study of textiles coated with conductive polymer
4.	**PHOTOELECTRONIC SPECTROSCOPY OF X-RAYS APPLIED TO TEXTILES**
4.1	Fundamentals
4.2	Surface sensitivity
4.3	Elemental chemical analysis
4.4	Chemical Displacement

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4.5	Quantitative analysis
4.6	Depth profile
4.7	Application to the study of textiles coated with conductive polymer
5. ELECTROCHEMICAL TREATMENT OF TEXTILE WASTE WATER WITH ACTIVATED CARBON FABRICS	
5.1	Platinized tin dioxide anodes
5.2	Anodes of activated carbon fabric with polyaniline and platinum
6. TEXTILES WITH GRAPHITE	
6.1	Graphite Applications
6.2	Textile conductors with graphite
6.3	EL-CELL® battery test cells and supercapacitors
6.4	Advanced fabric materials of activated carbon with conductive-graphite polymer

Finally, it is desired that the student achieves the following objectives:

- Apply electrochemical knowledge to topics of practical interest related to textiles.
- Acquire skills in the handling of instrumental laboratory techniques.
- Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.

Among all the subjects of the described study plan, it is highlighted Conductive Polymers Applied to Textile Materials, Smart Textiles and Biotechnology in the Textile Sector where the student can acquire very specific knowledge framed within technical textiles

11.2 Universitat Politècnica de Catalunya

This university has more than 80 master's degrees related to engineering, science and technology where students have the opportunity to study these subjects in depth, after finishing their bachelor's degrees.

11.2.1Study plan of the master's degree in Textile Design and Technology

One of these degrees is the master's degree in Textile Design and Technology, taught at the ESEIAAT, as the bachelor's degree. The main aim of this degree is to contribute to the technical and scientific training of professionals and prepare them for employment in a wide range of

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industries related to the textile sector, from spinning and fabric production to the design of innovative products and functional finishes.

Students receive advanced technological training in high added-value materials and processes and on innovation in processes and products. The training provided addresses current and future global needs in the sector from a technical, economic, and environmental perspective.

It has a duration of one year and 60 ECTS credits.

Table 21. Curriculum of the master's degree

	ECTS	COMPULSORY/ OPTIONAL
First Semester		
Advances in fibers and threads	5	C
Advances in dyeing and printing of fabrics	5	C
Advances in knitted fabrics and openwork	5	C
Advances in textile finishing and finishing	5	C
Sustainability in the textile industry	5	C
Instrumental techniques for R&D	5	C
Second Semester		
Smart fabrics	3	O
R&D management	3	O
Textile production in industry 4.0	3	O
Textiles for design and innovation	3	O
Final Project	18	C

11.2.2Study plan of the master's degree in Industrial Engineering

This master's degree, which qualifies graduates to practice the regulated profession of industrial engineer, aims to provide multidisciplinary scientific and technical training based on an overview of industrial engineering combined with specialization in a particular branch of industry.

One of these is Technical Textiles and Multifunctional Structures specialization, which has the following subjects:

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Table 22. Curriculum of the master's degree

	ECTS	COMPULSORY/ OPTIONAL
First Semester		
Advanced Automation and Control of Industrial Processes	2,5	C
Basic Instrumentation	2,5	C
Design and Behavior of Special Structures	3	O
Design and Construction on Industrial Plants and Related Facilities	5	C
Engineering of Thermal and Fluids Systems	7,5	C
Machine Design and Manufacturing Technologies	7,5	C
Operations Management	5	C
Project Management Key Agreements & Deals	3	O
Second Semester		
Agile Methodologies and Processes for the Creation of Innovative Solutions	3	O
Analysis and Design of Chemical Processes	5	C
Applications of Photonics Technologies	3	O
Architecture of Industrial Plants and Building Services	5	C
Biomedical Instrumentation	3	C
Data Mining and Machine Learning for Engineers	3	O
Demolitions and Soil Preparation	3	O
Designing Innovative Products and Business	3	O
Dynamic Analysis of Structures	3	O
Energy Technology	5	C
Environmental Management and Sustainability in the Textile Industry	5	C
Facilities Management	3	O
Functional Innovations in Textile Finishes	5	C
Implementation and Testing of Metaheuristics for Optimization Problems	3	O
Industrial Fluid Power	3	O
Infrared Thermography for Building Diagnostics	3	O
Introduction to Active Flow Control	3	O
Introduction to Metaheuristics for Optimization Problems	3	O
Management and Operation of Terminal Buildings	3	O
Mobile Robots	3	O

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Nonlinear Time Series Analysis	3	O
Photonics Sensors and Laser Technology	3	O
Power Generation, Transmission and Distribution	5	C
Power Transmission Systems (Fluid Power) II	3	O
Programming Interfaces and Applications	3	O
Project Management	5	C
Proportional Oil Hydraulics	3	O
Smart Sensors and Actuators for Internet of Things (Iot)	3	O
Smart Textiles	3	O
Theory and Design of Structures	2,5	C
Transportation and Materials Handling Engineering	2,5	C
Workshop on Fluid Power Transmission Systems	3	O
Third Semester		
Acoustics	3	O
Advances in Textile Fibers	5	C
Applied Robotics	3	O
Business Management	5	C
Chemical Technology	3	O
Colorimetry, Dyes and Pigments	5	C
Design of Experiments	3	O
Electrical Technology	3	O
Electronic Technology	3	O
Fundamentals of Nuclear Engineering	3	O
Fundamentals of Structural Calculation	3	O
Game Theory	3	O
Geotechnical Engineering	3	O
Quality Management	3	O
Railway Systems	3	O
Research Seminars	3	O
Science and Technology Communication Through Media	3	O
Structures of New Generation Materials	3	O
Surface Engineering	3	O
Theory of Machines	3	O
Thermal Turbomachinery and Combustion	3	O
Yarns, Filaments and Nonwoven Textiles	5	C
Fourth Semester		
Master's Thesis	12	C

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Functional Innovations in Textile Finishes

In the current environment, innovation has become a competitive priority of the highest order. The company has identified new products, processes and services, and being able to implement them.

The objective of the course is to provide the tools to develop innovative projects, managing innovation in all areas of the textile company to achieve competitive leadership

Develop the ability of students to identify areas of process innovation and textiles, structure them and present them to engineering projects

Boosting the knowledge of chemical finishing of fabrics, primarily from the points of view of the finished fabric quality aspects and ecological implications of products and processes. Study of biotechnological processes textiles

Table 23. Units of the subject Functional Innovations in Textile Finishes

1.	**Introduction**
2.	**Sol-gel finishing**
2.1	Concept of Sol-gel
2.2	Examples of applications of sol-gel finishing to textiles
3.	**Micro-nanoencapsulation finishing**
3.1.	Concept of Micro-nanoencapsulation
3.2.	Examples of applications of Micro-nanoencapsulation finishing to textiles
4.	**Plasma treatments**
4.1.	Concept of plasma treatments
4.2.	Examples of applications of plasma treatment on textiles finishing
5.	**Multifunctional and smart finishing**
5.1. Examples of applications of multifunctional finishing of textiles	

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5.2. Examples of applications of smart finishing of textiles

Smart Textiles

This course makes an introduction to smart textiles, of different types, from products with a memory shape to multifunctional nanotechnology.

It ranges from the base materials, that will form the products, to components and actuators, also taking into account their manufacturing processes.

Table 24. Units of the subject Smart textiles

1.	**Basic concepts**
	1.1. Definitions
	1.2. Basic principles 1.2.1. Shape memory 1.2.2. PCMs (phase -change materials) 1.2.3. Piezoelectricity, piezoresistivity, flexoelectricity, thermoelectricity 1.2.4. Optic fibers 1.2.5. Thermochromism 1.2.6. Photovoltaic systems 1.2.7. Functional nanotechnology 1.2.8. Others
2.	**Substrates for smart textiles**
	2.1. Textile materials 2.1.1. Woven fabrics 2.1.2. Knitted fabrics 2.1.3. Nonwoven fabrics 2.1.4. Other textile structures
	2.2. Non-textile flexible substrates 2.2.1. Elastomeric 2.2.2. Plastic films 2.2.3. Others
3.	**Components and actuators for smart textiles**
	3.1. Conductive yarns

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	3.2. Finishes 3.2.1. Inks 3.2.2. Coatings
	3.3. Other components
4.	**Processes for the development of smart textiles**
	4.1. Weaving and knitting
	4.2. Coating, active finishing, printing
	4.3. Embroidery
	4.4. Joining technologies
	4.5. Other production techniques for smart textiles
5.	**Case studies**

Finally, it is desired that the student achieves the following objectives:

- To know the main characteristics and properties smart and multifunctional textiles
- To be able to develop new smart textiles for specific applications

Advances in Textile Fibers

This course provides the necessary knowledge on the latest advances in the creation of textile fibers with new properties.

Table 25. Units of the subject Advances in Textile Fibers

1.	**INTRODUCTION TO THE INNOVATIONS IN TEXTILE FIBERS**
	1.1 Innovations in the field of high-performance fibers, high functionality fibers, nanofibers, biofibers, etc.
2.	**HIGH PERFORMANCE FIBERS**
	2.1 High mechanical performance fibers: Polyethylene HP, Polyamide HP, Polyester HP, Alcohol de Polyvinyl HP, Acrylic HP, etc.
	2.2 High thermally resistant fibers: polybenzoazole (PBO, PBI, PBIOH), polysulphurs of phenilene (PPS), fluorcarbonfibres, fibers

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	from thermoset polymers, Polyetherketones (PEEK), Aromatic polyamides, carbon fibers, glass fibers, ceramic fibers, etc.
3.	**HIGH FUNCTIONALITY FIBERS**
3.1	High comfort fibers
3.2	Conductive/antistatic fibers
3.3	Superabsorbent fibers
3.4	Antibacterial and antifungal fibers
3.5	Thermochromic fibers
3.6	Another high functionality fiber
4.	**FIBERS FROM BIOPOLYMERS**
4.1	Introduction to biopolymers
4.2	Fibers based on natural polymers
4.3	Fibers obtained from biomass
4.4	Fibers synthesized from microorganisms
4.5	Fibers synthesized from monomers obtained from biomass
4.6	Bast fibers
5.	**MICROFIBERS AND NANOFIBERS**
5.1	Introduction
5.2	Microfibers
5.3	Nanofibers: electrospinning, nanoweb structure, characterization, and applications

Finally, it is desired that the student achieves the following objectives:

- Ability to apply multivariate analysis techniques in market knowledge about materials and textiles in order to implement a flow production system.
- Ability to develop new fibers or yarns and woven and non-woven structures according to specifications and latest technologies for specific technical applications.
- Ability to manage and optimize production processes of technical textiles.

11.3 Conclusions - Textile Master's studies

As in the case of undergraduate studies, the supply of textile master's studies is very scarce in Spain.

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We can find two masters fully dedicated to this type of content, one at each university. Which offer more technical knowledge regarding textiles and have similar subjects as Smart Textiles or subjects related to polymers or advanced materials.

In the UPC, there are another master's degree that has a specialization in technical textiles and offers the student the opportunity to deepen this knowledge from the second semester with many elective subjects.

12. Conclusions

Finally, it can be said that higher textile technical studies are very scarce in the Spanish territory, compared to other branches of knowledge, which have a presence in almost all universities.

Undergraduate studies that deal with these topics focus on offering students the basic knowledge for their textile training, with subjects focused on textile materials, or the different types of structure and properties thereof. While in the master's degree courses, technical textiles are further explored, focusing, above all, on new advanced materials, technical applications, smart textiles, textile sensors, etc.

Subjects that involve knowledge of materials, the new opportunities offered by textiles in different sectors, the use of sensors or conductive materials on textiles or the functionalization of textile products, are considered of great importance, given their appearance in most of this type of studies, training in technical textiles.

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Recommendations

13. Stakeholders' survey

13.1 Methodology

This section discusses the results from the "Survey on stakeholders". The survey is conducted for recommendations relatively to bachelor and master studies, which will be transferred to Asian Universities.

Three partners contributed to this deliverable:

1. University of West Attica
2. University of Ghent
3. Technical University of Valencia

The survey was meant to provide useful information, for the development of the curriculum of Textile Engineering and Textile Technology studies focuses on smart and technical textiles. Owing to wide range of applications, the technical and smart textile products development needs knowledge from different fields.

13.1.1Target group

The target group of the survey was represented by two focus groups:
-1st Target group "academics and scholars"
-2nd Target group "industry representatives and experts", active professionals in the participating countries who are managers, CEO or owners or ocupy mainly managerial positions in the Textiles companies in different departments (Marketing, HRM, sales, R&D, Quality Control, Export etc.), approx. 15 respondents per country.

13.1.2 Tools

The survey was conducted through the **questionnaire**. Due to COVID pandemic an online version of the questionnaire was developed for completing the survey. The questionnaire was based on closed-ended questions and also provided respondents with the opportunity to add additional comments /proposals/ observations.

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Distribution mode:

The questionnaires were distributed in the three available modes: via e-mail (as attached document) or by sending the invitation to complete the online version.
Each partner was responsible for distributing the questionnaire to the national target groups with the aim to get input from approximately 15 persons per country, represented by academic staff and companies. They were also asked to forward it to other staff with managerial functions in their companies.
The survey was conducted from June 2020 to September 2020.

13.2 Analysis of the survey results

It follows the summarization of the answers, the comparison between the two target groups and the evaluation of the answeres with high score.

In order to analyze the result of survey, the answer of survey is coded.

Code of importance of knowledge.

Code	Answer
1	I don't know
2	Unimportant
3	Not very important
4	Important
5	Very Important

Code of Level of knowledge.

Code	Answer
1	Low knowledge
2	Medium knowledge
3	Deep knowledge

13.2.1 Target: Group-Academic staff

CODE	ANSWER	TOTAL Importance	TOTAL level of knowledge
1.Knowledge necessary for students and employees in textile and fashion industry			
1.1	Fundamental knowledge in physical and applied sciences:	45	28

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1.2	Fundamental knowledge in art (fashion and design):	47	28
1.3	Fundamental knowledge in textile and fashion* engineering:	51	28
1.4	Up-to-date knowledge in novel textile and fashion technologies and equipment:	51	22
1.5 Knowledge in specific fields of textile application			
1.5.1	Textile for medical and health care:	48	21
1.5.2	Fashionable protective textile:	44	24
1.5.3	Fashionable architecture and interior textile:	34	23
1.5.4	Fashionable transport and aerospace textile:	24	19
1.5.5	Agriculture and geotextile:	25	20
1.5.6	Fashionable sports and active leisure clothing:	44	31
1.5.7	Fashionable smart clothing:	42	24
1.5.8	Fashionable ecotextile:	43	23
1.5.9	Fashionable military textile	34	22
1.6Knowledge in development of innovative and smart textile with advanced properties			
1.6.1	Nanomaterials and nanotechnologies in textiles and fashion:	53	29
1.6.2	Micro-electronics in textiles and fashion:	47	24
1.6.3	Biotechnologies in textiles and fashion:	38	16
1.6.4	Fibrous and textiles based composites:	35	19
1.6.5.	New Fibres and Textile structures:	34	22
1.7.	Knowledge in area of informatics (programming and data treatment):	33	23
2. Professional skills necessary for students and employees in textile and fashion industry			
2.1	Ability to analyse and estimate recent information about new materials and technologies:	48	25
2.2	Ability to apply new methods and technologies in design and development of new materials and/or products:	47	23
2.3	Ability to research and estimate properties of new materials and products:	46	21
2.4	Ability to combine skills in novel textile technologies with fashion and design:	51	27
2.5	Ability to market new innovative fashion products:	50	24

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3.	Please specify other knowledge and skills important for professionals of textile and fashion industry: (*answer in one questionnaire*: *Textile technologists need to regain basic textile production skills ranging from the fibrous material to the finished product. My opinion is that with the increased focus on high technology, basic skills are getting lost from the Western Universities curriculums.)*		
4.	The importance of lifelong learning for professionals of textile and fashion industry:	49	
5.	Are you		
	- a student:	10	
	bachelor level	10	
	master level	0	
	The **programme you are studying**:		
	textile	10	
	fashion	1	
	- an employee	5	
	what area are you working in?		
	textile	4	
	fashion	2	
	graduation:		
	less than 5 years	1	
	5-10 years	0	
	more than 10 years	3	
	AVERAGE	39,88	20,2

13.2.2 Focus group 2 – Companies

CODE	ANSWER	TOTAL Importance	TOTAL level of knowledge
1. Knowledge necessary for students and employees in textile and fashion industry			
1.1	Fundamental knowledge in physical and applied sciences:	50	28

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1.2	Fundamental knowledge in smart textiles	55	25
1.3	Fundamental knowledge in textile and fashion* engineering:	50	25
1.4	Up-to-date knowledge in smart textile and fashion technologies and equipment	56	26
1.5 Knowledge in specific fields of textile application			
1.5.1	Textile for medical and health care:	16	16
1.5.2	Fashionable protective textile:	15	16
1.5.3	Fashionable architecture and interior textile:	19	17
1.5.4	Fashionable transport and aerospace textile:	13	16
1.5.5	Agriculture and geotextile:	12	16
1.5.6	Fashionable sports and active leisure clothing:	40	24
1.5.7	Fashionable smart clothing:	41	23
1.5.8	Fashionable ecotextile:	47	23
1.5.9	Fashionable military textile	10	16
1.6 Knowledge in development of innovative and smart textile with advanced properties			
1.6.1	Nanomaterials and nanotechnologies in textiles and fashion:	45	17
1.6.2	Micro-electronics in textiles and fashion:	44	16
1.6.3	Biotechnologies in textiles and fashion:	42	16
1.6.4	Fibrous and textiles based composites:	38	18
1.6.5.	New Fibres and Textile structures:	50	21
1.7.	Knowledge in area of informatics (programming and data treatment):	51	23
2. Professional skills necessary for students and employees in textile and fashion industry			
2.1	Ability to analyse and estimate recent information about new materials and technologies:	50	23
2.2	Ability to apply new methods and technologies in design and development of new materials and/or products:	49	20
2.3	Ability to research and estimate properties of new materials and products:	48	19
2.4	Ability to combine skills in smart textile technologies with fashion and design:	52	22
2.5	Ability to market new innovative fashion products:	53	20

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3.Please specify other knowledge and skills important for professionals of textile and fashion industry:			
4.	The importance of lifelong learning for professionals of textile and fashion industry:	51	19
5.	Are you		
	- a student:		
	bachelor level		
	master level		
	The programme you are studying:		
	textile		
	fashion		
	- an employee	15	
	what area are you working in?		
	textile	2	
	fashion	13	
	graduation:		
	less than 5 years	4	
	5-10 years	3	
	more than 10 years	8	
	AVERAGE	39,88	20,2

13.2.3 Comparison of answers to questionnaires between the two target groups

NO	ANSWER	IMPORTANCE	
		PUAS	HCIA-IDEC
1.Knowledge necessary for students and employees in textile and fashion industry			
1.1	Fundamental knowledge in physical and applied sciences:	45	50
1.2	Fundamental knowledge in smart textiles	47	55
1.3	Fundamental knowledge in textile and fashion engineering:	51	50
1.4	Up-to-date knowledge in smart textile and fashion technologies and equipment	51	56
1.5 Knowledge in specific fields of textile application			
1.5.1	Textile for medical and health care:	48	16
1.5.2	Fashionable protective textile:	44	15
1.5.3	Fashionable architecture and interior textile:	34	19
1.5.4	Fashionable transport and aerospace textile:	24	13

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1.5.5	Agriculture and geotextile:	25	12
1.5.6	Fashionable sports and active leisure clothing:	44	40
1.5.7	Fashionable smart clothing:	42	41
1.5.8	Fashionable ecotextile:	43	47
1.5.9	Fashionable military textile	34	10
1.6 Knowledge in development of innovative and smart textile with advanced properties			
1.6.1	Nanomaterials and nanotechnologies in textiles and fashion:	53	45
1.6.2	Micro-electronics in textiles and fashion:	47	44
1.6.3	Biotechnologies in textiles and fashion:	38	42
1.6.4	Fibrous and textiles based composites:	35	38
1.6.5.	New Fibres and Textile structures:	34	50
1.7.	Knowledge in area of informatics (programming and data treatment):	33	51
2. Professional skills necessary for students and employees in textile and fashion industry			
2.1	Ability to analyse and estimate recent information about new materials and technologies:	48	50
2.2	Ability to apply new methods and technologies in design and development of new materials and/or products:	47	49
2.3	Ability to research and estimate properties of new materials and products:	46	48
2.4	Ability to combine skills in smart textile technologies with fashion and design:	51	52
2.5	Ability to market new innovative fashion products:	50	53
3. Please specify other knowledge and skills important for professionals of textile and fashion industry:			
4.	The importance of lifelong learning for professionals of textile and fashion industry:	49	51

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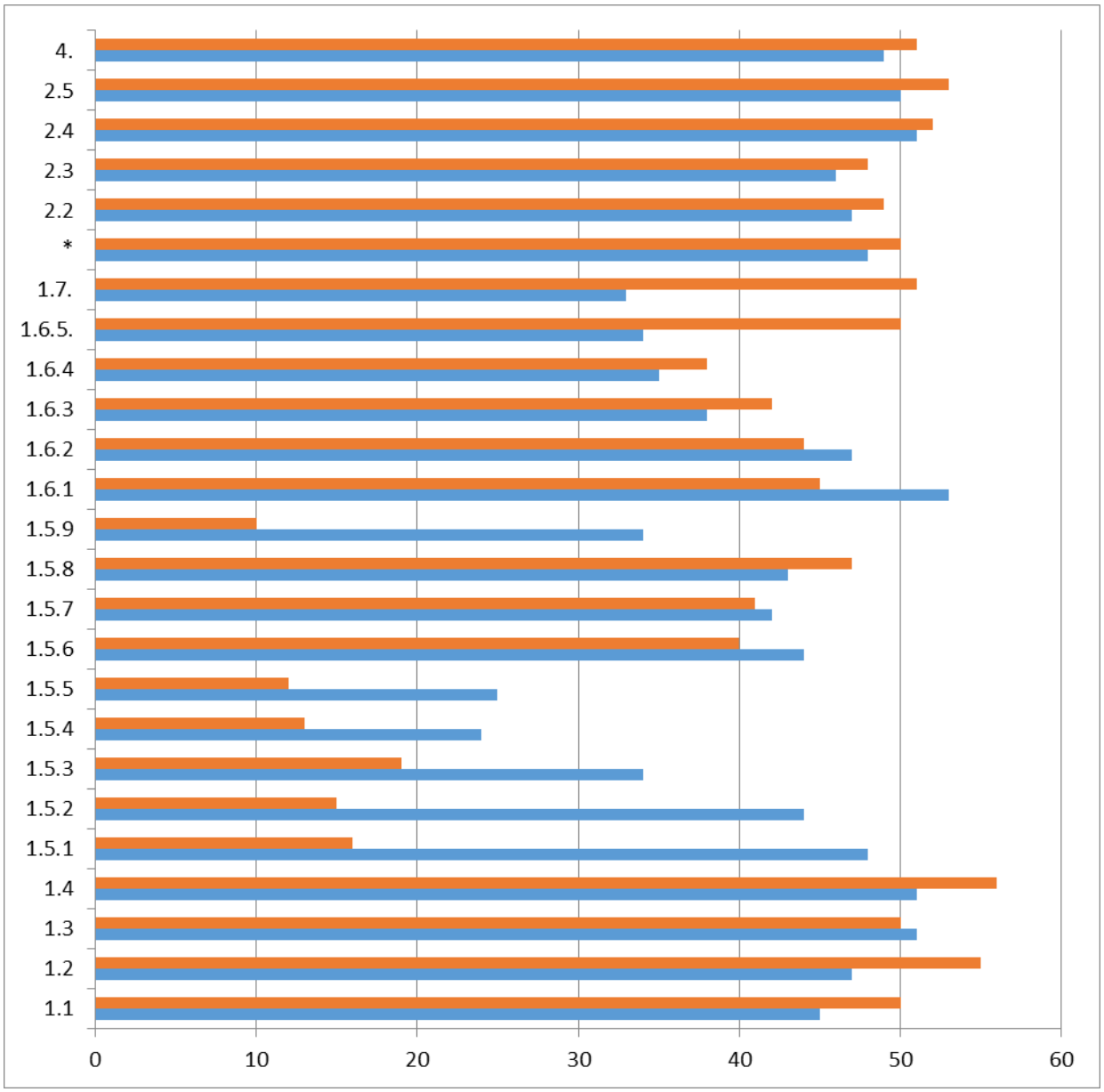
The answers to the questionnaires of the two focus groups are illustrated to the following diagrams:



Competence's students / graduates need to transfer to the Asian Partners

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According to the answers of the questionnaires, the most important skills and knowledge to be transferred are:

A/A	TITLE
1.2	Fundamental knowledge in smart textiles
1.3	Fundamental knowledge in textile and fashion engineering
1.4	Up-to-date knowledge in smart textile and fashion technologies and equipment
2.2	Ability to apply new methods and technologies in design and development of new materials and/or products
2.4	Ability to combine skills in smart textile technologies with fashion and design
2.1	Ability to analyze and estimate recent information about new materials and technologies
2.5	Ability to market new innovative fashion products

13.3 Conclusions-suggestions

Taking in mind the high-scored answers in the questionnaires, we realize that both students/academics and industry representatives consider as fundamental the enrichment of the curriculum with novel subjects related to smart textiles, materials and technologies. More specifically:

- Fundamental knowledge in smart textiles
- Fundamental knowledge in textile and fashion engineering
- Up-to-date knowledge in smart textile and fashion technologies and equipment
- Ability to apply new methods and technologies in design and development of new materials and/or products
- Ability to combine skills in novel textile technologies with fashion and design
- Ability to market new innovative fashion products
- Textile for medical and health care
- Micro-electronics in textiles and fashion
- Ability to analyze and estimate recent information about new materials and technologies
- Nanomaterials and nanotechnologies in textiles and fashion

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14. Recommendations for transfer to Asian Universities

The textile-oriented undergraduate studies in Greece are offered by two departments. Each of them offers comprehensive knowledge and skills in a different sub-sector of the textile industry ecosystem. The first focuses on materials, industrial processing, machinery, automations and production management, while the second focuses on fashion design, garment manufacturing and fashion trade. The higher specialization with a Master degree is still missing, however both departments aim to achieve a specialization through more advanced elective subjects, project-based activities and a final thesis, which is also elective. The new Textile Engineering Advanced Master 'WE-TEAM', in which the department of Industrial Design and Production of UNIWA participates as full partner, is expected to extend the specialization of graduates in the fields of advanced materials, smart textiles, high-tech applications and innovative business models.

Students in Belgium have two paths towards becoming a textile engineer. They can follow a broad Materials Engineering master, with specific major in polymers and fiber structures. This results in a big theoretical foundation applicable in the textile industry, with a focus on polymers, and supported by research groups in UGent in polymers, smart textiles, electrospinning, composites, artificial turf and more. For a more focused textile education, the International Textile Engineering master is available, with a focus on the full range of textile applications, as well as a closer integration with textile industry. In this way, the full needs of the textile industry in Europe can be covered. It must be noted that apart from the UGent academic majors, there are also University Colleges in Belgium offering professional bachelors in Textiles, which, as they are not academic, have not been covered in this part.

Finally, it can be said that higher textile technical studies are very scarce in the Spanish territory, compared to other branches of knowledge, which have a presence in almost all universities. Undergraduate studies that deal with these topics focus on offering students the basic knowledge for their textile training, with subjects focused on textile materials, or the different types of structure and properties thereof. While in the master's degree courses, technical textiles are further explored, focusing, above all, on new advanced materials, technical applications, smart textiles, textile sensors, etc. Subjects that involve knowledge of materials, the new opportunities offered by textiles in different sectors, the use of sensors or conductive materials on textiles or the functionalization of textile products, are considered of great importance, given their appearance in most of this type of studies, training in technical textiles.

According to the survey of stakeholder both students/academics and industry representatives consider as fundamental the enrichment of the curriculum with novel subjects related to smart textiles, materials and technologies.

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