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HIGHER EDUCATION AND BUSINESS



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Curriculum - Application of ICT in Design and Production of Textile and Clothing

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Curriculum - Application of ICT in Design and Production of Textile and Clothing

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(ICT - TEX)

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DISCLAIMER

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PROJECT CONTEXT AND OBJECTIVES

The textile industry is a tradition for Europe, with a centuries-old history, it is a leading EU sector offering high quality and innovative products. According to EURATEX Annual report 2017, the EU-28 is the world's largest market for textile and clothing products with household consumption of € 511 billion, a 181 billion turnover and 1.7 million workers employed. The EU Textile and Clothing industry (TCI) consists of 176,400 companies, 99% of which are small and medium-sized niche players focusing on quality, innovation, creativity and outstanding customer service.

The development of the necessary competences and skills for existing workforce and the attraction of qualified young experts has become a priority for companies. TCI is facing important challenges due to the changes in the working processes determined by different factors:

- technological development lead by new environmental protection and Corporate Social Responsibility requirements;
- evolution within manufacturing techniques with introduction of automatic cutting systems, advances in IT supporting product design and manufacture, and growing robotization of tasks;
- increasing introduction of Information and Communications Technology (ICT) ;
- innovation in materials with the rise of technical and smart textiles.

The impact of the above mentioned factors on the requirements for skills is enlarging the area of expertise to drive forward the innovation and ensure Textile and Clothing (T&C) products meet the aims of the industry, as well as the abilities needed to master both existing and new equipment and techniques.

Additionally, the successful professional realization of the specialists of the sector will require knowledge in the field of entrepreneurship.

The existing University curricula do not always meet the needs for ICT, digital and entrepreneurial education. Thus, the current bachelor's and master's engineering degrees are not fully adapted to the business needs. The study standards have to be moved up onto the next level according to both EU and business priorities, technical and technological development and the new approaches for digital and smart specialization.

Following the main recommendation of ESSC, a framework for a rapid response to the current evolution in business models, processes and sales strategies, in terms of continuous training and competences provision, needs to be established.



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With the aim to strengthen T&C Europe's innovation capacity and foster innovation in higher education, the project main objectives are:

- Develop innovative and multidisciplinary approaches to teaching and learning, developing ad hoc curricula and syllabuses in cooperation between universities and business;
- Stimulate entrepreneurship and entrepreneurial skills of higher education teaching staff and company staff;
- Facilitate the exchange, flow and co-creation of knowledge;
- Outline special requirements for training and education of specialists suitable for TCI producers, incl. technical, digital and entrepreneurial skills provision;
- Introduce innovative schemes for transversal skills training and enhancement throughout higher education programmes, developed in cooperation with enterprises and aimed at strengthening employability, creativity and new professional paths.

The planned activities and expected results of ICT-TEX project are shaped to address the outlined needs of the target groups (students, trainers, academics and textile SMEs) and to meet the ambitious objectives established. The project will develop a set of innovative tools based on a knowledge transfer dynamic approach. These tools will include:

- Gap analysis resulting in the “Report on developing requirements of TCI technologies”
- “Map of ICT technologies in TCI” Report
- “Map of innovation models and entrepreneurial skills in TCI” Report
- The curriculum “Application of ICT in Design and Production of Textile and Clothing” that meet the requirements (resp. digital and entrepreneurial competencies) of the TCI business.

At least 7 validated Study programmes (syllabuses) for technical, digital and entrepreneurial education complying with the latest company requirements; practically oriented and interactive; remotely usable. The syllabuses will be developed following specific topics:

- ICT technologies and digital skills
- Design and production of knitwear
- Design and production of technical, smart and intelligent textiles
- Finishing printing and functionalization.
- Entrepreneurial and innovation skills
- Design and production of woven fabrics
- Industrial engineering, quality control and management

All the above mentioned e-tools will be available for consultation from the project web-platform.

AIMS AND STRUCTURE OF THE CURRICULUM

If the development and the benefits associated with the ICT systems applications to the textile and clothing sector are considerable, a barrier to a better digitalisation of the industry is represented by the shortage of skilled personnel. The use of breakthrough technologies to drive innovation in TCI requires new knowledge & skills and a clear view on what is necessary for the staff' successful realization. The very fast ICT technology development and the steady innovation path characterizing the Textile and Clothing industry requires:

- The introduction of new approaches to stimulate target groups' digital knowledge and skills;
- The introduction of innovative methodologies to develop target groups' entrepreneurial skills.

The Curriculum "*Application of ICT in Design and Production of Textile and Clothing*" summarizes the sectoral future needs of staff competences, knowledge and skills for the employability of students and the competitiveness of TCI enterprises. It is meant to be flexible enough to meet the different needs (resp. process and operational) of various TCI specialized enterprises. The curriculum is structured into modules, with selectable programs, in this way each user will be able to choose only those programs that are useful for his/her own pathway. For each course different study materials are developed, addressed to three main target groups:

- Trainees (students)
- Practitioners (staff)
- Trainers (university teachers/researchers)

The courses are designed to be interactive, and through the access to an open platform, learners are able to select and to follow the interested programs, promoting distance learning. The proposed curriculum and programmes are not linked to the academic credit system, leaving to the specialists the freedom to select the courses of the programme to be studied. They offer an engineering approach to design, production, organization and quality control directly related to the use of ICT.



Methodology

The Curriculum is intended to respond to the real skills needs of the staff operating in different TCI sectors with the objective to modernize the existing curricula and to adopt a more business friendly learning approach. These goals have been achieved by combining the findings coming from:

- **Staff skills needs assessment:** defining the best employee and his/her current and future technological competencies, knowledge and skills. The assessment was conducted by the mean of a questionnaire aimed at detecting the staff' current technical skills and the skills desired for the ICT progression of companies operating in different TCI specialised sectors.
- **Analysis of anticipating skills reports:** defining the skills most required in the future by the employees on the basis of the current development trends in TCI industry.
- **Study of existing HEIs curricula and syllabuses:** defining new courses closer to the business practices focused on technological and digital aspects. The curricula of the consortium Universities and other Higher Educational Institutions not part of the project have been analysed in order to identify good university practices, innovate the programs and make them more digitally friendly.

Curriculum Requirements

Respond to the staff future skills needs

- Analysis of the anticipating skills reports
- Analysis of the questionnaire evidences about skills need assessment
- Analysis of HEIs current curricula

Be Flexible

- Able to meet the needs of different TCI specialized enterprises
- Based on a modularity approach
- Remotely accessible

Be practically oriented

- Offering an engineering approach to design, production, organisation and quality control directly related to the use of ICT
- Based on interactive tools (videos, demonstrations, case studies)

Observe National and University standards

- Comply with the EQF Format
- Contain all the elements to be accepted as an elective facultative course (respect of content and form standards)



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1. Skills need assessment – Analysis of the questionnaire evidences

In order to fully understand the TCI enterprises special needs in term of skilled personnel endowed with those skills and competences required to better exploit the opportunities offered by new technologies and digital enhancement, the ICT-TEX project consortium elaborated a questionnaire addressed to T&C companies coming from the countries part of the project consortium.

The questionnaire was structured into sections, three of them common to all respondents: company general information / need for ICT skills / need for entrepreneurial skills. The other ones linked to the company specialisation: design and production of woven fabrics / design and production of apparel / design and production of knitwear / design and production of technical and smart textile / finishing, printing specialised companies.

63 companies replied to the questionnaire giving us important insights into their production procedures, technological development, innovation propensity and especially staff' current and desired skills:

- Most of the companies interviewed use automatic programs, even if the production stages are mainly managed by the personnel, this means there remains a large benefit to be obtained by better embedding automated systems in the production process.
- Innovation is considered an important aspect by the T&C companies, who indeed require from their employees the ability to improve the production lines and to develop new kind of products. On the other hand, they believe that these kind of competences, together with those related to technological and ICT skills are the ones that the technical staff need to improve the most.
- The ability to manage machineries exploiting the possibilities offered by the latest functionalities is among the competences most required, so covering also all the functions based on software, representing nowadays machineries essential components.
- Among the skills most required by the companies working in the smart textile sector there is the ability to develop new smart products, this means also the skills connected to the development of sensors and ICT components.
- Finishing printing and functionalisation specialised companies have low propensity in the adoption of innovative technologies for the companies in the sector. The main constrains in their introduction are probably due to the initial investments but also to the lack of specialized professionals able to properly operate with them. Indeed we can see that among the skills most needed by the companies of the sector we find technical abilities and special knowledge mainly related to specific dyeing and printing processes, as for example rotary screen printing technology, raster printing, colorimetric and so on.



In particular, going more in detail into the questionnaire findings, the competences and abilities most required by the TCI employees, following their specialisation, are reported here:

Design and production of apparel:

- To fully develop the clothing patterns, specifically: grading details, patterns development for specific kind of clothing as jackets, blouses and shirts

Design and production of knitwear:

- To manage and optimize production products; to use machines latest features; to programme machines; to use newest CAD/CAM software and to improve automated systems application

Design and production of technical and smart textiles:

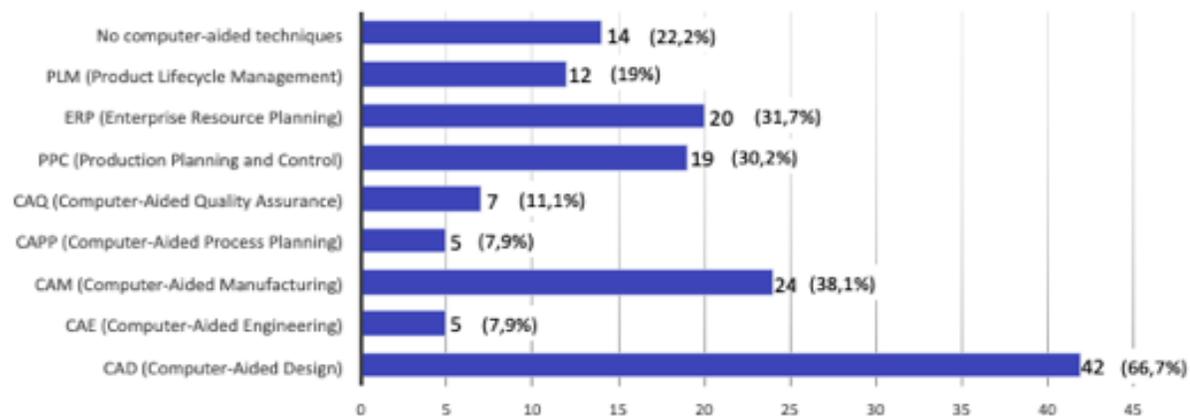
- To develop new smart products; to use machines latest features assuring their maintenance and proper programming; to manage and optimize production processes; to use newest CAD/CAM software and to improve automated systems application

Finishing / printing specialized companies:

- To use rotary screen printing technology, raster printing, reactive and pigmented dye; to improve knowledge and skills about dyeing chemicals, colorimetric and spectrophotometry; to improve knowledge and skills about innovative technologies as for example 3D printing, digital printing, electrospinning, plasma and spin-knit technology

Concerning the common questions about digital and entrepreneurial skills need we find that, among the computer-aided techniques, the most used are surely the CAD systems with 66,7% of usage. Also, CAM systems are used by a good percentage 38,1%, then we have ERP with a percentage of 31,7% and PPC with 30,2%. However, a significant figure is represented by the high percentage of companies that do not use any computerized systems, about 22,2% of the total.

9.6 What kind of computer-aided techniques are implemented in your company?



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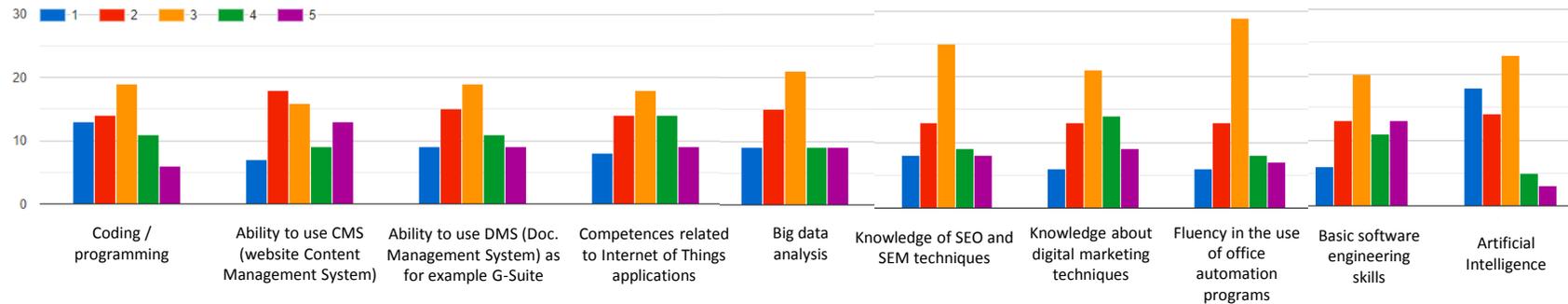


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Respondents perceive that integration of ICT systems needs to be improved into the belonging companies, indicating among the skills shortage those needed to operate with advanced / automated production systems; to manage integrated systems for the exchange of information between different production processes also embedding Internet of Things (IoT); to improve the integration level of CAD/CAM and ERP systems.

Furthermore, for what relates to transversal ICT skills, we can note that among the listed skills the ones that the companies believes their employees need to improve mostly are the knowledge about social media / digital marketing instruments and basic software engineering skills, immediately after we have big data analysis and then the use of CMS and office automation programs.

9.4 Please evaluate the relevance of the following ICT skills for your company by assigning a grade between 1 (very low) and 5 (very high)



In order to get advantage from the opportunities offered by new technologies and digital advancement, and to obtain a strategic advantage into the market, it is also important to develop those transversal skills related to the improvement of an entrepreneurial mind-set.

Personal features are particularly important to lead a successful company or more in general to get a managerial position. Among the personal skills respondents feel to have the most, we find: creative thinking and problem solving, self-confidence, goals setting planning and organizing abilities, decision making, willingness to learn and leadership. On the other hand, among the skills that need to be improved, we find conflict resolution, ability to recognize the other employee's potentials, financial and economic literacy.

These aspects also effect the ability to innovate the business model, about which the main efforts to do concern the improvement in the ability to deal with the changes in the regulatory framework and economic trends; to introduce new technological innovation; to take advantage from services offered by incubators, hubs, management consultancy agencies; to innovate selling channels, resources composition and value proposition.

2. Skills need assessment – Analysis of the anticipating skills reports

The analysis of skills anticipating reports have given us other important elements to develop a Curriculum respondent not only to the current TCI needs in term of skilled personnel but also to the latest market technological advancements, anticipating those competences that will be important in the near future.

The most important findings come from the report “The future of work in textiles, clothing, leather and footwear” developed by the International Labour Office, Sectoral Policies Department (Geneva: ILO, 2019).

Here the main findings and recommendations from the report:

Key findings on needs for technological skills

- Ability to use laser cutters, 3D printing, sewbots (new robotics and automation technology) i.e. automatic cutting machines and robotic arms
- Knowledge and ability to use new machines, processes able to limit water consumption in dyeing, reduce waste
- Knowledge and ability to process new materials, e.g. fibres made from bamboo, orange trees
- Knowledge and ability to apply techniques able to improve materials performance (e.g. control body temperature, control odours), connect the users with web application, enhance aesthetics, protect the wearer against dry skin, radiation (i.e. Drug-realising textiles)
- Ability to artificial engineering nanomaterials, e.g. cotton-blend fabrics that kill bacteria or conduct electricity, ultra-thin silicon circuits, which could lead to high-performance medical and communication instruments that can be worn, and even metamaterials that make whatever they cover undetectable
- Ability to use technologies and innovative ways to recycle materials



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Key findings on needs for ICT and digital skills

- Knowledge and ability to apply and manage:
 - Radio Frequency ID (RFID) task
 - Sensors and Internet of Things coupled with new software
 - Augmented Virtual Reality (AVR)
 - Block-chains and Artificial Intelligence
- Ability to use ERP systems to better manage production planning and control, supply chain, logistics, costumers relationships, workloads and work distribution, environmental impact, quality
- Ability to use advanced design software, i.e. software able to detect contours and body shapes for tailor-making designs
- Ability to use specialised software and analyse big data in order to study current market trends and predicts the future ones
- Ability to use marketing techniques and tools to better targeting specific consumer categories and groups .
- Ability to use social media to engage and interact with customers and influence their buying behaviours

Recommendations

It will become increasingly important to manage skills development and skill shortages in order to ensure that employers and workers are able to adapt to new technologies, new materials and growing pressure to manufacture products in an environmentally sustainable way.

The lack of a highly skilled and trained workforce, able to operate robotics and digital technologies, could slow the rate of automation in the industries disproportionately. Alongside training new workers will increasingly mean re-skilling and up-skilling existing workers through life-long learning. Special attention should be given to those working in the TCLF industries today, the young women and migrants that tend to have a low level of education and are locked in low-paid production line work without the opportunity to progress into management or supervisory roles. Governments, employers and workers in the industry will have to adopt sustainable, integrated approaches to provide both women and men with the necessary life-long training to maintain a competitive advantage in the industry, whether in developed, emerging or developing countries, and to reskill workers in countries or segments of the supply chain where the industries decline. This will require a complete change of mind-set in industries that for decades have thrived on the abundance of low-skilled workers and rudimentary low-cost technologies. It will also require a radical overhaul of education and training systems, coupled with significantly increased investments in human resources development for the millions of mostly young women and men that work in the TCLF industries today. Investments in education, training and lifelong learning will increasingly determine to what extent employers and workers seize opportunities and address the challenges of a digitalized world of work.



3. Analysis of the existing HEIs curriculum

What to improve?

From the analysis of the existing courses developed both by the HEIs part of the project consortium and by external Universities, there emerged important elements that have been taken into account in the curriculum design process. While the courses are highly technical oriented with a great focus on materials, production and process techniques also foreseen the use of specific software (most of all in the apparel dedicated courses) there still some improvements to be implemented in order to contribute to curricula modernisation:

- Adoption of a competency-based-education in term of learning process based on innovation-leading technologies able to personalise student navigation of to-be-mastered contents
- Availabilities of tools for remote learning
- Link with and direct involvement of T&C enterprises
- Better introduction of ICT (both transversal and TCI specific) and innovative technologies based courses in the curriculum in order to keep the pace with the market evolution
- Integration of more effective strategies oriented to improve entrepreneurial skills and attitudes giving more attention both to financial and business management aspects and to transversal skills developments
- More practical oriented approach : learning by doing / case studies / scenarios



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4. Adoption of the EQF format

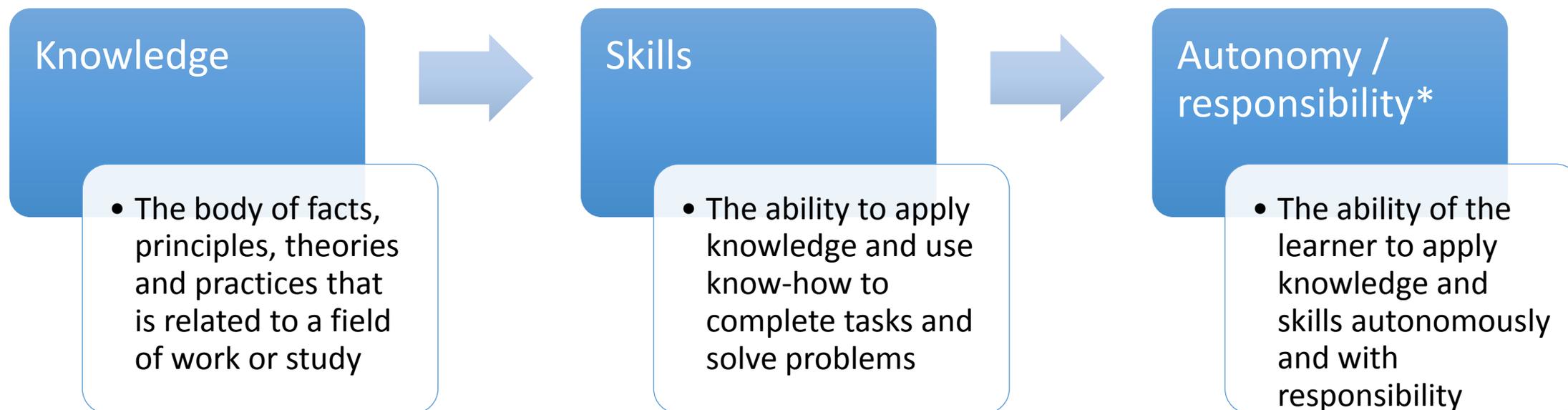
The European Qualification Framework, as a common European reference tool, acts as a translation grid which links countries qualification systems / framework



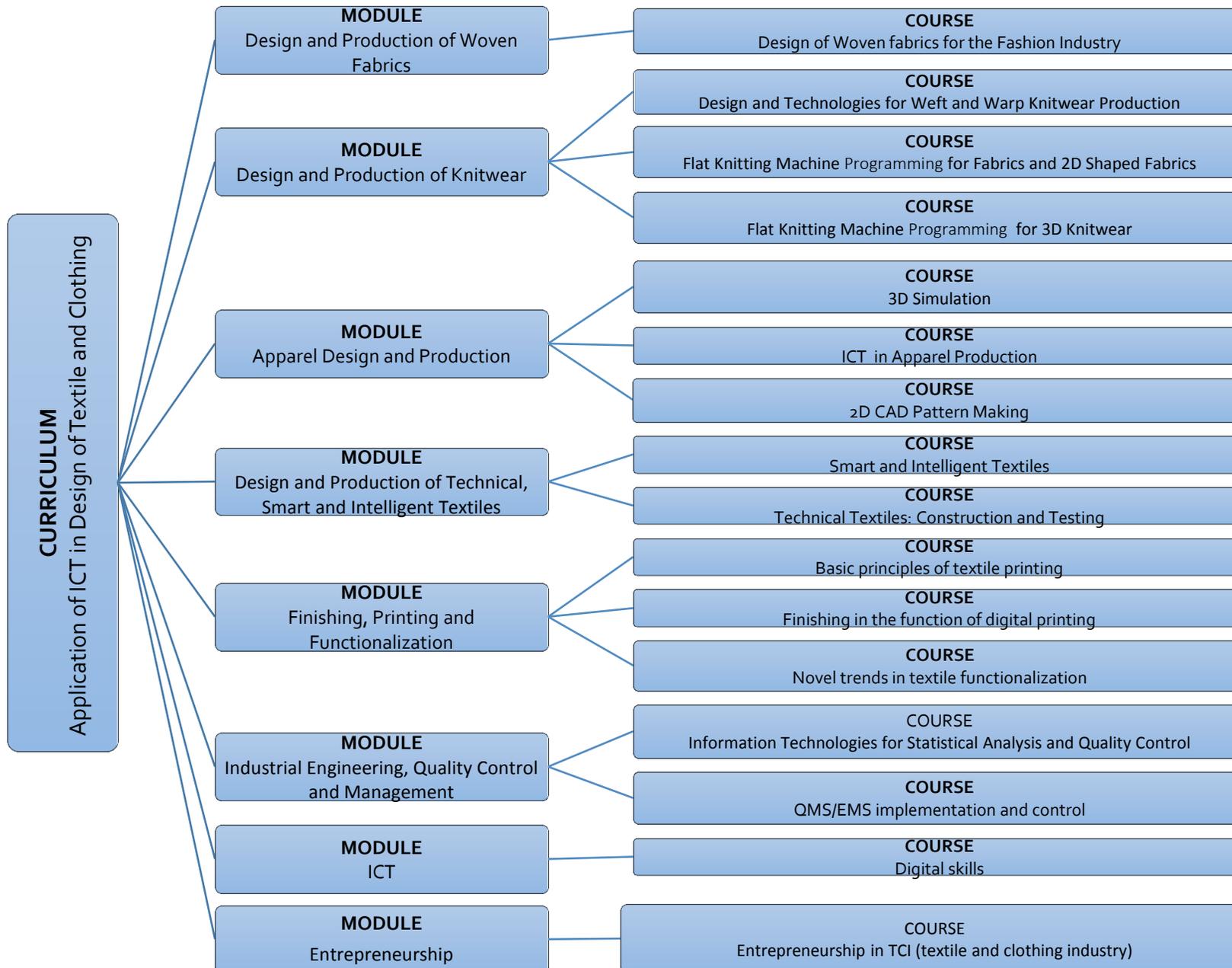
Objectives:

To ease the link with the National and European qualification systems

In the EQF a learning outcome is defined as a statement of what a learner knows, understands and is able to do on completion of a learning process, emphasises the results of learning. Learning outcomes are specified in three categories:



*Reception of council Recommendation of 22 May 2017 on the EQF for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the EQF for lifelong learning (2017/C 189/03)



MODULE – DESIGN AND PRODUCTION OF WOVEN FABRICS

Course: Design of Weave Patterns for the Fashion Industry

Duration: 30 hours

Course objectives

Designers of woven fabrics are challenged with bringing together creative flair and technological know-how to create fabrics that not only excite, but perform for a given market and end-use. The course deals with the design of weave patterns for fabrics, which could be used in the fashion industry or in the interior design. They involve only one warp set and one weft set. All themes would involve theoretical explanations of the types of weaves and application of a CAD/CAM software.

Topics

- Fabric construction and wave patterns
- Elementary weaves: plain, twill, satin, sateen and their derivatives
- Application of CAD/CAM to the weave pattern design
- Weaves to obtain different effects on the fabric
- Different kind of design methods

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To know the weave structure: warp and weft unit, draft and lifting plan- To understand how woven fabrics are made: technology of weaving and characteristics of woven fabrics- To be aware of the woven fabrics different properties Be able to Design colours and materials for the creation of orthogonal- To understand different manufacturing techniques- To get basic knowledge of weaves and interlacing points fundamentals- To understand different manufacturing techniques	<ul style="list-style-type: none">- To use software for graphic representation- To create regular repeating patterns- To calculate wave units, repeat and fabric width- Be able to realise different effects of fabrics using different kind of weaves patterns- To design colours and materials for the creation of orthogonal fabrics through the use of CAD/CAM systems- To apply different kind of patterns design methodologies	<ul style="list-style-type: none">- To manage patterns production processes- To structure a fabric production line- To set pattern design using CAD/CAM systems



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MODULE – DESIGN AND PRODUCTION OF KNITWEAR

Course: Design and Technologies for Weft and Warp Knitwear Production

Duration: 20 hours

Course objectives

The knitting technology has been playing a very vital role in our life style. Knowledge developed in the past, particularly in the last 50 years in the field of knitting technology has contributed significantly to the developments of state-of-the-art machinery on one hand and highly sophisticated and specialised textile products on the other. Advanced knitting machines capable of producing high-value apparel require highly skilled programmers and designers with technical understanding. The course will provide an in depth overview about the operations and functionalities of the most spread knitting machines and the associated design structures.

Topics

- Circular knitting machines
- Flat knitting machines
- Sock knitting machines
- Rashel knitting machines
- Tricot knitting machines

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To understand the main functionalities, components, properties and control systems in circular / flat / sock / Rashel / tricot knitting machines- To state the operations peculiarities and differences between the analysed type of machines- To understand different manufacturing techniques and knitting design structures- To explore changing tension, yarn thicknesses and colour	<ul style="list-style-type: none">- To operate and exploit the latest functionalities of the most spread knitting machines- To apply different knitting techniques- To use holding & short row knitting to develop three-dimensional knit structures, volume, shapes, and techniques	<ul style="list-style-type: none">- To develop original aesthetics through application of 2 and 3 dimensional techniques- To develop creative design outcomes through the combination of materials and processes



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MODULE – DESIGN AND PRODUCTION OF KNITWEAR

Course: Flat Knitting Machine Programming for Knit Fabric and 2D Shaped Fabric

Duration: 20 hours

Course objectives

Knitting is one of the most exciting textile technologies of creating products with outstanding characteristics, such as: knitting to shape, great flexibility in production, controlled properties, and excellent formability. Knitting process has few important phases and one of them is the pattern design stage. In case of computer controlled flat knitting machines, the patterns are developed on special pattern stations, with a specific programming language. The course will show in a practical way how to program flat knitting machines in order to produce 2D shaped fabric.

Topics

- Knitted structures
- Step and procedures for knit programming
- Graphical software for colour knits
- Parameters and functions settings
- Pattern creation

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To identify basic knit constructions- To understand characteristics and properties of different knitted structures and the most suitable applications for each one- To get knowledge of the different steps needed to machine programming for a new 2D fabric- To explore changing tension, yarn thicknesses and colour- To get knowledge of graphical software main functionalities and possibilities	<ul style="list-style-type: none">- To relate knitting parameters and the mechanical properties of the structures to define the better design for the application purpose- To set programs for knit fabrics manufacturing accordingly to features, structures and colours combinations- To use graphical software to set knit structures, shaped fabrics patterns, and coloured knit motifs- To use Sintral program design: panel structure drawing, yarn carrier allocation and knitting set up (i.e. carriage speed, fabric density, fabric take-down)	<ul style="list-style-type: none">- To develop original aesthetics through application of 2 dimensional techniques- To develop creative design outcomes through the combination of materials and processes- To apply different manufacturing and assembly technologies, grading details and identifying manufacturing defects



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MODULE – DESIGN AND PRODUCTION OF KNITWEAR

Course: Flat Knitting Machine Programming for 3D Knitwear

Duration: 20 hours

Course objectives

3D knitting is a digital fabrication method that uses large flatbed knit machines to create complete, seamless garments in one piece, eliminating all post-production assembly, opening the doors for new applications such as customisation, made to measure and on-demand production; which will make the manufacturing process more sustainable, distributed and localized. This technological evolution requires the development of new design, systems and programming knowledge. The course will show in a practical way how to program flat knitting machines in order to produce 3D knitwear.

Topics

- 3D knitting techniques and applications
- Steps and procedures for 3d knitting programming
- Design 3D knitwear using specific software
- Parameters and functions settings
- 3D Patterns creation

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To be aware of 3D knitting applicability and processes- To apprehend different 3D architectures- To recognize advantages and disadvantages of different techniques and technologies in the manufacture of 3D knitted garments- To have an overview of the different methods used for patterns creation for a given 3D geometry	<ul style="list-style-type: none">- To combine machine and yarn typology for making a certain garment having specific characteristics- To apply pattern making methods in accordance with body anatomy and measurement- To program 3D garment pattern design, grading details- To implement all the different steps to create 3D geometries: patching, course generation, loop generation, 2D knit pattern generation- To set accurate and uniform machine parameters for the overall 3D geometry- To use 3D simulation software to program the patterns	<ul style="list-style-type: none">- To develop original aesthetics through application of 3 dimensional techniques- To develop creative design outcomes through the combination of materials and processes



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MODULE – APPAREL DESIGN AND PRODUCTION

Course: 3D Simulation

Duration: 30 hours

Course objectives

Three-dimensional (3D) virtual prototyping is getting increasingly importance for apparel design. Based on the utilization of 3D CAD simulation, the product development in the clothing industry becomes faster and faster. The integration of 3D CAD systems for garment design leads to higher accurate cloth fitting. During the course the participants will be guided to create the virtual garments from fashion design idea analyzing the principal aspects of 3D simulation by using specific software.

Topics

- Introduction of 3D simulation
- 3D virtual model
- Virtual fit simulation in CLO3D

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To have an overview about the application of 3D simulation in the clothing sector- To evaluate pro and cons of 3D simulation- To be aware of the different steps and methods to apply in the 3D simulation process- To understand the importance and the procedure to create a 3d virtual model- To get knowledge of the main functionalities of the CLO3D software	<ul style="list-style-type: none">- To realise an avatar choosing the more suitable principles and characteristics in accordance with the product purposes and features- To apply different methods to generate a 3D human model, checking for and making eventual corrections and setting a system of sizes- To run CLO3D software using its different functionalities: avatar customization, 2D patterns settings, material and details characterization, grading, rendering and animation- To evaluate the fit, making corrections and changes to obtain the desired result / effect	<ul style="list-style-type: none">- To develop a fashion solution using 3D virtual prototyping technology sourcing from traditional craftsmanship knowledge- To translate ideas and vision into experiments and digital products relating them to fashion tendency and production processes- To use traditional garment craftsmanship



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MODULE – APPAREL DESIGN AND PRODUCTION

Course: ICT in Apparel Production

Duration: 30 hours

Course objectives

The garment industry invariably goes through short fashion cycles. To survive in the market, regular innovations in colour, style, design, fabric, finish and fit are needed. Automated machinery and IT solutions are keys in such a scenario. Automations for cutting, sewing, buttonholes, CAD/CAM for pattern making, etc., have brought down the cost of production considerably. Garment companies now focus on technology to be productive and cost-effective at the same time, which means skilled and constantly updated workforce. The course is focused on the analysis of the interconnections between innovative technologies and standard production process in order to equip learners with relevant skills and knowledge.

Topics

- Sewing machines
- Automation in apparel production
- Spreading/cutting
- Material management and work planning
- Finishing
- Welding technologies
- Production systems

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none"> - To know different type of sewing machine, including the automatic ones, being aware of their components and specific functionalities - To appraise automation practices in apparel production, their peculiarities and applications - To apprehend different type of cutting and welding technologies - To understand material management and work planning principles - To understand the features of different apparel production systems, digitalization and machine networking systems 	<ul style="list-style-type: none"> - To operate different kind of sewing machines, being able to fix the different problems that may occur during the operations - To set the sewing machine in accordance with the apparel production type - To apply cutting and joining methods and technologies - To use CAD software for pattern making - To set inventory control systems for material flows management - To use digital tools for maintenance purposes - To apply different finishing processes being able to proceed to their digitalisation 	<ul style="list-style-type: none"> - To set an effective work-planning defining a sewing floor for smooth production management - To select the production system more suitable for the production type, using digitalization to increase the efficiency



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ICT IN TEXTILE AND CLOTHING
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MODULE – APPAREL DESIGN AND PRODUCTION

Course: 2D CAD Pattern Making

Duration: 30 hours

Course objectives

Today's clothing industry is moving toward using advanced technology in designing and pattern-drafting. Clothing companies continuously seek new solutions for saving time in product development and generally increasing efficacy in activities ranging from the design process through the manufacturing process. Such programs can enhance communication, ease flow, and produce cost effectiveness at all stages. 2D CAD Pattern Making is a knowledge-intensive and creative course that will lead learners across different pattern making techniques taking into consideration materials, colours and styles combination. Lessons are taught using specialized CAD software (e.g. AccuMark by Gerber Technology, Modaris by Lectra).

Topics

- Introduction to CAD functionalities
- Algorithms for pattern making of basic apparel constructions
- Algorithms for pattern making of specific garment elements
- Modeling techniques for different garments
- Darts manipulations
- Design of gathered elements
- Computer grading of details
- Development of production patterns
- Modelling of knitwear clothing

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none"> - To be aware of pros and cons of CAD clothing systems - To understand the software main features and functionalities - To know and understand different textile material properties and related design techniques principles - To understand body anatomy, measurements and grading - To appraise symmetry and asymmetry in the construction of clothing - To acquire a sense of the volume, proportions and aesthetics criteria - To know different grading methodologies 	<ul style="list-style-type: none"> - To apply modelling techniques (splitting/combining, flipping, rotation, symmetry and asymmetry principles) - To calculate structural dimension of the drawing parts applying proportionality principles - To apply different pattern making methods according to style and functional requirements - To apply different techniques for the design of gathered elements (folds, pleats, draperies) - To practice specific pattern making algorithms for specific garment elements and details (sleeves, collars, lapels, pockets, facings) - To grade details using different functions, making measurements and adjustments 	<ul style="list-style-type: none"> - To entirely manage the different phases for a garment modelling and prototype - To recognize and take into account the connections between design, material properties and production requirements - To translate design elements into new products paying attention to aesthetic and formal qualities and performance (comfort, safety, durability, etc.)



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ICT IN TEXTILE AND CLOTHING
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MODULE – DESIGN AND PRODUCTION OF SMART TEXTILE

Course: Smart and Intelligent Textile

Duration: 20 hours

Course objectives

Smart textiles are fabrics that have been designed and manufactured to include technologies that provide the wearer with increased functionality. These textiles have numerous potential applications, such as the ability to communicate with other devices, conduct energy, transform into other materials and protect the wearer from environmental hazards. Research and development towards wearable textile-based personal systems allowing health monitoring, protection and safety, and healthy lifestyle, gained strong interest during the last few years. The purpose of the course is to train an "Expert for research and innovation in the smart textile sector" by teaching the essential basics of textile technology and deepening the new development trends relating to materials, processes, ICT application and markets.

Topics

- History of Smart Textile and latest development
- Classification of Smart Textile: passive / active / ultra
- Application of Smart Textiles
- Smart materials and fibers in Smart Textile: i.e. conductive inks/ optical fibers/ phase change materials
- Incorporating smartness into textiles
- Machines last features for smart and intelligent textile production

Learning outcomes

Knowledge	Skills	Responsibilities / autonomy
<ul style="list-style-type: none">- To understand the different types of smart materials that can augment garments and what their effects are- To understand the models to simulate the effect of smart materials- To know the latest developments of smart textiles- To be aware of the machines last features for smart and technical textile production processes- To be aware of the different applications of Smart and Intelligent Textiles	<ul style="list-style-type: none">- To suggest what smart materials to use for specific use cases- To create designs for augmented garments- To create models to simulate augmented garments- To construct an intelligent garment- To program an intelligent garment- To properly integrate sensors / actuators, energy sources, processing and communication within the clothes	<ul style="list-style-type: none">- To update an existing product portfolio with state-of-the-art smart materials- To manage software engineers and non-textile specialists in creating a smart garment- To create and program a basic intelligent garment with textile sensor, data processing unit and textile actuator



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MODULE – DESIGN AND PRODUCTION OF SMART TEXTILE

Course: Technical Textile: Construction and Testing

Duration: 20 hours

Course objectives

Technical textiles are fiber-based products used in applications other than apparel and home furnishing. Familiar examples of these are home / automotive filters, airbags, seat belts, parachutes, bulletproof vests, firefighter turnout suits, face masks, etc. In addition, there are many notable examples of inconspicuous use of textile products in tires, civil construction and geotechnical engineering. The course content focuses on product design principles, understanding of applications, materials, and technologies relevant to the vast array of technical textile materials and products.

Topics

- Technical textiles applications: Buildtech / Agrotech / Clothtech / Geotech / Hometech / Indutech / Medtech / Oekotech / Packtech / Protech / Sportech
- Biomimetic
- Design through CAD, CAM
- Performance Evaluation of Textiles
- Specialized production techniques: nonwoven, 3D weaving, 3D knitting, complex braiding, e-textile embroidery
- Design of Experiment (DOE)

Learning outcomes

Knowledge	Skills	Responsibilities / autonomy
<ul style="list-style-type: none">- To understand the different types of technical textiles and related applications- To know the production methods and the differences compared to apparel- To apprehend about technical textile design methodologies- To know the techniques to evaluate technical textiles	<ul style="list-style-type: none">- To evaluate the application possibilities of new textile techniques- To design some selected technical textiles (braid, composite, ...)- To develop a DOE through software- To test data and standards accomplishment with specific software- To apply CAD and CAM system functionalities to technical textile design	<ul style="list-style-type: none">- To apply a technical textile solution within the non-apparel sectors- To setup a DOE within a company- To certify typical technical textile performance: breathability, permeability, filtration capacity, strength.



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MODULE – FINISHING, PRINTING AND FUNCTIONALIZATION

Course: Basic Principles of Textile Printing

Duration: 20 hours

Course objectives

The entry of ICT into analogue, conventional textile printing technology, which involves the use of rotary or flat screens, has revolutionized its development. It is the most demanding stages of the process, such as sample design and sample-to-screen preparation, that become the points of the most significant implementation of information technology. With the introduction of the CAD system, the printing process itself is being digitized, enabling automation in the management of the printing machine and control of the handling of the printing paste. The aim of the course is to acquire the skills and knowledge of conventional screen printing, aiming in mastering the abilities of using the ICT tools in designing and overall printing process, and to point out the role of textile printing techniques in smart textile production.

Topics

- ICT in textile printing methods and techniques
- Smart printing pastes
- CAD application in textile screen printing
- Dyes and pigments with special effects (thermochromic, photochromic, phosphorescent, fluorescent, biomimetic)
- Dye and pigment based textile printing

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none"> - To consider all possibilities of ICT tools applications in technology of analog textile printing - To select printing methods in response to market demands, with economy and environmental acceptability - To know the basics of rheology as the foundation of the printing pastes preparing process - To understand the creative aspect of textile printing technology and get acquainted with new printing methods for special and smart effects realization - To understand the difference of bonding mechanism of dyes and pigments 	<ul style="list-style-type: none"> - To make a screen for performing printing using new techniques - To select the thickener depending on the printing technique, dye and textile material used - To select and apply the appropriate printing method for a certain type of material, a particular purpose and to achieve a certain effect - To define the relevant parameters regarding the effect and the print quality desired - To perform different textile printing techniques 	<ul style="list-style-type: none"> - To be responsible for the application of environmentally and economically sustainable printing paste as well as printing method - To be able to optimize quantities of printing paste in order to avoid significant waste of chemicals - To propose a short project of industrial design by using the textile printing techniques as the main creative tool - To be responsible for developmental approach to the scope of exploring and applying new techniques and smart dyes and pigments

MODULE – FINISHING, PRINTING AND FUNCTIONALIZATION

Course: Finishing in the Function of Digital Printing

Duration: 30 hours

Course objectives

ICT is a fundamental carrier of the development of digital printing in general and the transition of digital technology from graphic to textile printing. Digital printing allow to respond to market demands extremely quickly, with immediate and unique design personalization, and significant savings in water and energy. The aim of the course is to acquaint participants with the methodology of using ICT tools in designing and final printing process, to explain the basic features of the development of digital textile printing with emphasis on modern research trends in this field explaining the different types of textile pre-treatment in digital printing, such as plasma pre-treatment, chitosan pre-treatment, cationization, etc.

Topics

- ICT as fundamental aspects of digital textile printing development
- Technical characteristics of digital textile printing
- Innovative approaches in digital printing pre-treatments processes
- Current trends in the development of digital textile printing technology
- innovative approaches in the formulation of printing inks and modifications

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To know the complex interaction of heterogeneous textile structure and printing ink: concepts of deformation, penetration, porosity- To understand the methods of pre-processing and post-processing of textiles as key stages in the application of the digital technology- To understand the difference between dye-based and pigment-based printing inks and the difference in the mechanism of their bonding to textile materials- To get acquainted with innovative methods of textiles pre-processing depending on the composition of the printing ink and the use of dyes or pigments	<ul style="list-style-type: none">- To use the ICT tools in designing and printing process- To be able to handle a digital printing machine- To identify and predict the interaction of textile material and printing ink depending on the structure and raw material composition- To apply certain pre-treatment methods in dependence of textile material structure and composition- To analyse the results of given pre-treatments- To examine the difference in color and print quality with respect to the applied pre-treatment	<ul style="list-style-type: none">- To manage a digital printing device independently- To take into consideration the environmental legislation related to the textile industry and the application of certain chemicals- To apply responsibly pretreatment methods always considering the method with the least environmental impact- To contribute to team work on setting the basic parameters of the printing process, pre-processing and post-processing of textiles



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MODULE – FINISHING, PRINTING AND FUNCTIONALIZATION

Course: Novel Trend in Textile Functionalisation

Duration: 30 hours

Course objectives

The aim of this course is introducing learners with specific functional properties of textiles as self-cleaning, super-hydrophobic, antimicrobial, flame retardant, etc. which are results of functionalization of textiles as an emerging tool for improving textile performance and increase its added value. Some of established techniques which could be used to impart new functionalities and properties to textile materials including cold plasma processing, electrospinning, sol-gel process, foams, enzymatic treatments, nanotechnology, wet processes, spraying, polymer coating. Through the course it will be described the processing equipments, the physical-chemical nature of the polymer materials, as well as the most important functionalities provided by these techniques. A new generation of new high-value textiles developed by surface treatment, chemical grafting, 3D structure, and nanotechnologies to introduce and develop textiles with new functionalities will be described. The course will be focused on the use of innovative ICT technologies, eco-friendly processes in order to equip learners with relevant skills and knowledge, as well as with responsibilities for developing a novel material functionalities and environmentally friendly.

Topics

- Functional textiles
- Sustainable development
- Emerging technologies
- Materials with novel functionalities
- Plasma technology
- Nanotechnology

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To apprehend specific functional properties of textiles using surface engineering methods- To understand novel textile material properties and treatment processes- To analyse different methods of textiles production- To connect and understand textile material structure with their functional properties	<ul style="list-style-type: none">- To operate different processes for textile treatments- To analyse the obtained properties using appropriate methods- To set process parameters for achieving desired functionality- To use novel fabrication methods for develop (multi)functional textile properties- To use innovative sustainable chemical finishes to develop high added value textiles without negative impacts on both the consumer and the environment	<ul style="list-style-type: none">- To select the environmentally friendly methods and chemicals for increase the efficiency- To determine advantages and current challenges of using novel materials to obtain the desired functional properties



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MODULE – INDUSTRIAL ENGINEERING QC & MANAGEMENT

Course: QMS / EMS Implementation and Control

Duration: 20 hours

Course objectives

The quality of textile products need to be assured in accordance with modern production and environmental requirements. Quality specification, conformity and environmental assessment of textile products are integral part of the production process and can contribute to an enterprise differentiation strategy. Students will be introduced in the definition of systematic approach in quality assurance and quality management with the support of the latest ICT systems. They will learn how to set an organisation effective management system (QMS) and environmental management system (EMS) in accordance with the standard requirements with the support of the latest technologies.

Topics

- Quality management system (QMS) according to ISO 9000
- Environmental management system (EMS) according to ISO 14000
- Certificate of conformity
- PDCA (plan-do-check-act) loops for quality assurance
- LCA (Life cycle assessment) concept in sustainability of textile process and production

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To understand the systematic approach to quality assurance and quality management of textile and clothing products- To apprehend the standardized model of environmental management system (EMS) according to ISO 14000- To understand the concept of Life Cycle Assessment (LCA), identify the elements of LCA, their relationship and impact on the environment- To adopt the principles of assessing and labelling the ecological characteristics of processes and products- To recognize product quality as a strategic category essential for business success	<ul style="list-style-type: none">- To apply the general quality management system ISO 9000- To support the introduction of systematic quality management in the organization- To use statistical tools for product quality management- To use the PDCA quality loop to improve business quality and product development- To use the methodology for the implementation of EMS in the company according to ISO 14001- To use the concept of LCA as relevant tool in sustainable development	<ul style="list-style-type: none">- To contribute to the definition of systematic approach in quality assurance and quality management, setting specific goals and key factors that need to be monitored, measured and harmonized with legislation at the level of the organization- To interpret the data and adjust the variables according to the defined goals in the different segments of work and production phases



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MODULE – INDUSTRIAL ENGINEERING QC & MANAGEMENT

Course: Information Technologies for Statistical Analysis and Quality Control

Duration: 30 hours

Course objectives

Information technology systems can improve quality and increase productivity. In addition to software different statistical methods can be used to evaluate critical processes in order to control production procedures and performances. The course in Information Technologies for Statistical Analysis and Quality Control includes basic issues of mathematical statistics and its application for the needs of the textile and clothing industry. The training will be carried out mainly with universal and, if necessary, with specialized software products.

Topics

- Seven basic quality tools (7BQT)
- Seven new management and planning tools
- Quality function deployment (QFD)
- Failure mode effects analysis (FMEA)
- Statistical estimates and hypothesis testing
- Probability distributions with application in textile practice
- Analysis of variance (ANOVA)
- Regression models

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To understand the basics of the quality control tools- To aware and understand the essentials of QFD- To comprehend the elements of FMEA method- To understand different probability distribution, parameters and properties related to textilae variables- To apprehend how to treat random variables in order to consider them in the quality control process- To adopt different kind of hypothesis testing to support your decisions- To comprehend variance and regression analysis principles	<ul style="list-style-type: none">- To solve problems using the quality control tools- To respond to the needs and expectations of the customers using QFD- To take actions to eliminate or reduce failures using FMEA- To represent test results using different methods- To use specialised software for data analysis to support quality control- To apply statistical hypothesis tests in Statistical Process Control (SPC) and Acceptance Sampling (AS)- To apply variance and regression analysis to concrete cases both for forecasting and control purposes	<ul style="list-style-type: none">- To assure and manage the quality control process by using the quality control tools- To bring new and improved products to market while reducing development time.- To documents current knowledge and actions about the risks of failures- To optimise the regression model in order to get to the best possible hypothesis considering data variables- To support the quality control process by applying relevant statistical models



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MODULE – ICT

Course: Digital skills

Duration: 30 hours

Course objectives

ICT as a general purpose technology can improve business practice, increasing the efficiency and competitiveness of industries. Also manufacturing industries as TCI have been invested from this technological revolution. Nowadays most production processes can be automated, design proposals are generated and developed using CAD/CAM systems, the internal and external communication take mainly place via web, hardware can exchange information enhancing operational procedures. In this module we are going to introduce the learners to the programming language, software modelling, visualization and embedded systems having different application in the Textile and Clothing industries.

Topics

- Fundamentals and Introduction to ICT
- Basic ICT tools
- Tools for business digitalization
- Computer graphics & visualization
- Development and maintenance of websites
- Introduction in programming
- Software engineering
- Introduction to Artificial Intelligence
- Internet of things and embedded systems
- Business analytics
- ICT in enterprise management
- Introduction in programming

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To basic knowledge of widely used basic ICT concepts and tools- To understand how information is stored and processed in computers- To be aware and understand programs and algorithms used in programming- To understand the different phases of software engineering: requirements, design, development, testing and maintenance- To get knowledge about internet of things and embedded systems- To get acquainted with AI, ML and data analytics- To get acquainted with the ERP systems applications and potentialities	<ul style="list-style-type: none">- To be able to use and apply most common ICT technologies and tools into business- To apply variables and identifiers in processes programming- To set up control mechanisms for the management of business operations- To use unified modelling language for software design implementation- To operate with programmable logic controller for the control of manufacturing process such as assembly lines and robotic devices- To run CAD/CAM software for TCI application as pattern scale, adjustment, design components- To set key performance indicators and benchmarks to measure processes and business performance	<ul style="list-style-type: none">- To autonomously work with document management software- To set collaborative instruments able to facilitate the information and document sharing among the staff- To apply basic programming principles and practices- To develop a digital marketing campaign to increase your business visibility and obtain strategical advantages- To analyse the production processes and define effective automated control mechanisms- To use business intelligent architectures to perform data analysis and take strategical and operational decisions



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MODULE – Entrepreneurship course

I: Basic entrepreneurial competencies and prerequisites in TCI

Duration: 15 hours

Course objectives

The course will help students to self assess their entrepreneurial knowledge and attitudes in order to support them in the building process of an entrepreneurial mindset. Students will learn about the main characteristics and competencies of an entrepreneur and how to develop them with the aim to succeed in their professional path and eventually to start their own businesses in TCI. The course will cover both behavioural aspects of entrepreneurship, as for example leadership, sense of initiative and innovative mindset, and technical, economic and business knowledge related to financial, managerial and legal aspects.

Topics

- Fundamentals of Entrepreneurship in the Textile and Clothing Industry
- Entrepreneurial Self-Assessment
- Main Stages of the Entrepreneurial Process in the Textile and Clothing Industry
- Textile and Clothing Industry Environment for Entrepreneurs
- Marketing Planning of the Textile and Clothing Business
- Innovations in the Textile and Clothing Industry

Learning outcomes

Knowledge	Skills	Responsibilities/autonomy
<ul style="list-style-type: none">- To understand the basic aspects, related to entrepreneurship, business economy and enterprise management- To understand the main features of a successful entrepreneur- To be aware of the individual entrepreneurial skills to be improved- To outline idea generation processes- To understand business management techniques and methodologies- To state market analysis techniques- To appraise the current status of the technological innovation in TCI	<ul style="list-style-type: none">- To apply idea generating techniques to stimulate the innovation process- To conduct an evaluation of available opportunities- To collect and critically analyse the information- To apply market analysis techniques to evaluate a business idea- To build a marketing strategy- To define a business model	<ul style="list-style-type: none">- To take risk to start a new business- To apply for entrepreneurial supportive measures- To build a network around a business idea- To manage workgroups for new idea generation- To be responsible for scheduling and monitoring of the procedures required to start-up a new business



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MODULE – Entrepreneurship course

II. Entrepreneurship in TCI

Duration: 15 hours

Course objectives

To start-up a successful business in the textile and clothing sector requires a deep knowledge of the market, its composition, segmentation and technological status. The course will equip students with specific knowledge and skills related to market analysis techniques, project management and business planning, resource and financial management, relationship and commercial networks building.

Topics

- Value and Subcontracting Chains in the Textile and Clothing Industry
- Regulation, Registration and Support of the Entrepreneurial Activity in the textile and Clothing Industry
- Financing of an Entrepreneurial Business in the Textile and Clothing Industry
- Business Planning for a Textile and Clothing Enterprise
- Practical Steps for Starting Your Own Textile and Clothing Business
- The Entrepreneurial Roadmap in the Textile and Clothing Industry

Learning outcomes

Knowledge	Skills	Responsibilities / autonomy
<ul style="list-style-type: none">- To acknowledge the main programs / opportunities supporting TCI innovation and technology transfer- To understand the main aspects related to finance and funding- To have an in-depth knowledge about business planning- To understand the main procedures to start a new business- To identify the regional and national support programs and organisations for entrepreneurship	<ul style="list-style-type: none">- To build a winning team- To set price policies and analyse the financial results- To define a business plan, set goals and monitoring results- To apply all the steps required to start-up a new business- To build an entrepreneurial networks and supply chain setting instrument for their management	<ul style="list-style-type: none">- To define an efficient financial structure combining risk capital, venture capital and public grants- To set effective techniques and instruments for human resource management- To be responsible for strategic business decisions as for example investment choices, business partners, marketing actions- To be responsible for the overall business organisation- To apply for entrepreneurial supportive measures



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