FASHIONAISE

Course Syllabus

AI-Driven Innovations in Sustainable Fashion Design

Co-funded by the European Union

Course Description

This course bridges the gap between traditional fashion design, sustainability, and the rapidly evolving landscape of Artificial Intelligence. Moving beyond simple generative design, this curriculum prepares students for the "Product Era" of AI, where tools are integrated into complex workflows rather than serving as novelties.

Students will explore how Agentic AI (autonomous systems that perform tasks) is reshaping the value chain, from upstream biological material sourcing to downstream consumer discovery. A core focus is placed on Sustainability and Circularity, utilizing AI to facilitate Digital Product Passports (DPP), optimize resale models, and reduce waste through precision manufacturing. The course also addresses the critical "Author vs. Automaton" debate, teaching students to maintain creative integrity in an automated age.

Course Content

The course is structured into 6 Learning Modules.

Module 1: Foundations of AI in Fashion

This module moves beyond the basics of Generative AI to introduce the "Product Era" of AI. It establishes the theoretical framework for Agentic AI, autonomous systems capable of planning and executing tasks, which is set to redefine industry operations by 2026. Crucially, it addresses the "Authorship in the Age of Automation" debate, examining how designers can maintain creative integrity and navigate copyright ethics while using automated infrastructure. In addition, the module introduces ethical considerations related to AI use in fashion, including intellectual property, data bias, transparency, and the role of the designer as a human curator of AI-generated outputs.

Knowledge

- Understand the transition from Generative AI to the “Product Era” of AI in the fashion industry.
- Explain the principles of Agentic AI and its impact on fashion workflows.
- Understand authorship, copyright, and ethical challenges related to AI-assisted design.

Skills

- Analyze AI-supported fashion design processes from a theoretical and ethical perspective.
- Identify risks related to authorship, copyright, and automated decision-making in design.

Attitudes

- Value human creativity and authorship within AI-augmented design environments.
- Adopt a responsible and ethical mindset when engaging with automated design systems.

Module 2: Sustainable Fashion and AI's Role

This module explores the intersection of technology and ecology through the lens of Upstream AI. Students will examine how computational biology (Bio-AI) allows for the design of climate-resilient raw materials at the genetic level. It also covers the regulatory landscape, specifically how AI and Blockchain facilitate Digital Product Passports (DPP) to comply with the EU's Ecodesign for Sustainable Products Regulation (ESPR) and automate waste sorting for circularity. The module further introduces AI-driven material analysis, zero-waste pattern optimization, and predictive tools aimed at reducing material consumption and production waste.

Knowledge

- Understand the role of AI in sustainable and circular fashion systems.
- Explain the use of Bio-AI and computational biology for climate-resilient material development.
- Understand the purpose and regulatory context of Digital Product Passports (DPP) and ESPR.

Skills

- Interpret AI-driven data related to material sustainability and lifecycle impacts.
- Apply AI-based approaches to waste reduction and circular fashion strategies.

Attitudes

- Recognize sustainability as a core design responsibility rather than an optional feature.
- Support the use of AI as a tool for environmental responsibility and circularity.

Module 3: Market Analysis & Concept Development

Focusing on the new frontier of "The AI Shopper," this module demonstrates how autonomous AI agents are disrupting traditional search and discovery. Students will learn the principles of Generative Engine Optimization (GEO), structuring brand data to be visible to AI, and how to utilize AI for "Efficiency Unlocked," using dynamic pricing and demand forecasting to prevent overstock and align production with volatile economic climates. AI-driven trend analysis, social media data scanning, and AI-generated mood boards are introduced to support data-informed concept development and accelerated ideation.

Knowledge

- Understand how autonomous AI agents are transforming search, discovery, and consumer behavior.
- Explain the principles of Generative Engine Optimization (GEO), dynamic pricing, and demand forecasting.

Skills

- Structure brand and product data to improve visibility for AI-driven discovery systems.
- Use AI-supported market analysis to align design concepts with demand and reduce overproduction.

Attitudes

- Appreciate data-informed creativity as a complement to intuitive design thinking.
- Adopt a market-aware and efficiency-oriented design approach.

Module 4: AI-Powered Design Process

This module dives into the technical application of AI in the creative workflow, emphasizing HumanAI Collaboration. It covers the translation of AI-generated concepts into manufacturable reality ("First-Time-Right"), ensuring that generative designs are not just

aesthetic but producible. A key focus is placed on using AI to reinterpret cultural heritage and folklore patterns respectfully, bridging tradition with algorithmic design (e.g., using pattern-generation AI to analyze historical archives of Turkish Kilim motifs, Bulgarian Shevitza embroidery, and Greek traditional textile and embroidery motifs—such as the woven and decorative patterns of Metsovo and other regional embroidery and weaving practices, and to translate these geometries into modern, zero-waste textile prints.). Computer vision-based body geometry recognition, avatar creation, and AI-supported pattern generation are incorporated to improve fit accuracy, enable mass customization, and reduce production errors.

Knowledge

- Understand human-AI collaboration within creative and technical design workflows.
- Explain the process of translating AI-generated concepts into manufacturable designs.
- Recognize the role of AI in respectfully reinterpreting cultural heritage and folklore patterns.

Skills

- Apply AI-supported methods to improve design accuracy and production readiness.
- Integrate cultural and creative references into AI-assisted design processes responsibly.

Attitudes

- Respect cultural heritage when using AI as a creative tool.
- Value producibility and technical feasibility alongside aesthetic quality.

Module 5: Digital Fashion, Virtual Fitting and Prototyping

Centering on the virtualization of product development, this module teaches the creation of "Digital Twins" to replace physical sampling and reduce carbon footprints. Alongside Virtual Try-On (VTO) technologies, this module now includes the emerging category of Smart Wearables and Smart Frames, exploring how fashion brands are integrating style with multi-modal AI hardware (e.g., RayBan Meta) to capture new market segments. Advanced virtual fitting, stress analysis, and AI-driven customization tools are used to minimize return rates and further optimize sustainability in digital product development.

Knowledge

- Understand the concept of Digital Twins and their role in virtual product development.
- Explain the principles of virtual fitting, Virtual Try-On (VTO), and smart wearable technologies.

Skills

- Use digital prototyping approaches to reduce physical sampling and carbon footprint.
- Apply virtual fitting and customization concepts to improve product development efficiency.

Attitudes

- Embrace digital-first approaches to product development and testing.
- Support innovation that enhances sustainability and user experience simultaneously.

Module 6: Digital Fashion Innovation

This forward-looking module examines the shift from "growth at all costs" to Circular Profitability. It highlights the "Resale Sprint," teaching students how AI automates authentication, pricing, and listing to make second-hand business models scalable for brands. It also critically evaluates the evolution of digital assets, moving from speculative NFT hype to functional digital identities and service-based models (rental/repair) powered by AI logistics. Virtual fashion shows, digital showrooms, and AI-enabled on-demand manufacturing models are additionally examined from a critical sustainability and circular economy perspective.

Knowledge

- Understand circular profitability models, including AI-enabled resale and second-hand markets.
- Explain the evolution of digital assets from speculative NFTs to functional digital identities and services.

Skills

- Analyze AI-driven business models related to resale, rental, and service-based fashion.

- Critically assess the commercial and sustainability value of emerging digital fashion innovations.

Attitudes

- Maintain a critical perspective toward technology-driven hype.
- Favor long-term, value-driven, and sustainable digital innovation strategies.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. **Knowledge**
    - Distinguish between Generative AI (creation) and Agentic AI (autonomous task execution) within the fashion ecosystem.
    - Understand the regulatory landscape, specifically the EU Ecodesign for Sustainable Products Regulation (ESPR) and the role of Digital Product Passports (DPP).
    - Analyze the environmental impact of AI compute power versus the savings generated by digital sampling and supply chain optimization.
    - Explain key ethical challenges of AI in fashion, including intellectual property, data bias, transparency, and authorship.
    - Understand the role of Responsible AI within the European regulatory and sustainability framework.
2. **Skills**
    - Utilize AI tools for Generative Engine Optimization (GEO) to ensure products are discoverable by AI shopping assistants.
    - Apply AI-driven analytics for upstream innovation, such as genomic selection for sustainable fibers.
    - Operate virtual prototyping software to create "Digital Twins" that serve both manufacturing and marketing needs.
    - Design strategies for circular business models, specifically focusing on AI-enabled resale and sorting.

- Apply ethical decision-making when selecting datasets, AI tools, and automated design outputs.
- Evaluate AI-generated fashion concepts for bias, cultural sensitivity, and sustainability impact.

3. **Competence**
    - Develop a cohesive brand voice and visual identity that retains human authorship while leveraging automated efficiency.
    - Critically evaluate the commercial viability of emerging tech trends, distinguishing between hype (e.g., pure Metaverse) and value drivers (e.g., efficiency and resale).
    - Act as a human curator of AI outputs, maintaining creative authorship, accountability, and ethical integrity in AI-assisted design processes.

Teaching Methods

Given the intensity of this workload (3 ECTS = 75-90 h) and the fast development pace of the technological sphere, a blended, process-oriented model will be used in this course. The learning model will shift the focus from mastering specific software tools which will become outdated quickly to developing prompt engineering logic and other processes of working with AI technologies. Therefore, the teaching methodology is divided into five major components described below.

Blended Delivery via the Digital Atelier Hub

- **Asynchronous Theoretical Learning:** Students will access the theoretical foundations and regulatory frameworks (ESPR, DPP) as well as industry cases through the Digital Atelier Hub.
- **Synchronous Practical Studio Sessions:** Students will participate in face-to-face or virtual lab sessions aimed at practical, challenge-based learning.

The Hybrid Progression Strategy (Individual to Team-Based)

Taking into account contemporary work trends and approaches, the strategy includes two main phases:

- **Phase 1:** Individual Skill Building (Modules 1-3)

The first few modules will feature individual assignments where students build creativity and learn technical prompts and skills for working with AI technologies (generating mood boards, conceptualizing ideas based on data).

- **Phase 2:** Collaborative Studio Simulation (Modules 4-6)

As the project progresses, assignments will involve teamwork in solving complex issues in the digital fashion design (e.g., virtual fitting or digital prototyping). This phase is dedicated to creating a realistic environment simulating the process of working in a digital fashion studio, with role rotation and pairing (e.g., taking turns acting as Creative Directors, 3D modelers, or Sustainability Analysts).

Process-Oriented Learning & "Quick & Dirty" Approach

In order to make assignments realistic and appropriate for the 3 ECTS workload, practical work will focus on the prompt engineering processes and "quick and dirty" approach where students learn to work quickly without paying much attention to perfection while using AI technologies. Students will be tasked to experiment with generation in order to learn to work as curators and think critically instead of simply operating the tools.

Challenge-Based Learning & Mock Pitches

Challenge-based assignments will involve using AI tools for solving contemporary industry challenges related to sustainability, including (for instance) zero waste pattern cutting or virtual sampling aimed at reducing carbon footprint. Students will take part in mock pitches and presentations of projects to clients.

Reflective Practice

As part of the reflective component of the coursework, students will keep an "Ideas Journal" or "Prompt Log" describing their creative processes, collaboration with AI, reinterpretation of cultural and folklore elements, and ethical aspects of the process.

Assessment Criteria

This course focuses on the process of thinking, working with AI tools, and using responsible design practice methods. Therefore, your final grade will be assigned on the basis of how you think, work with AI, and use responsible design practices, not necessarily how aesthetically pleasing your final image is. Since an AI can produce great looking pictures quite easily, you will be graded on your intentionality, prompt strategies, and technical skills.

Your final grade will depend on your performance in the Digital Portfolio Assessment which will consist of two types of assignments: individual developmental tasks and a group project.

There will be five major aspects for evaluating your project:

1. **Concept & Creative Direction (25%)**
    - **Originality & Vision:** How clear was your concept? Was your creative direction original? Did you have control over your ideas, or were you using the tool to come up with a concept?
    - **Cultural Sensitivity:** If your assignment involved folklore elements or traditional patterns, you will be judged on your preliminary research, references, and respect towards original culture (avoid cultural appropriation). For instance, students must avoid generic AI prompts (e.g., "ethnic pattern") and instead use historically accurate, researched terminology in their prompt engineering (e.g., "Czech Modrotisk blueprint technique" or "Greek Meander motif"), documenting these reference sources in their Prompt Log.
2. **AI Collaboration & Prompting Strategy (20%)**
    - **"The Prompt Log" / Ideas Journal:** You will need to document your iterative prompting process. You will be judged on how your prompts developed and how you applied different constraints to narrow down the results of your AI work. In addition, you will be required to show evidence of conversation with AI.
    - **Intentionality:** Were you able to use an AI as a helpful solution to a specific problem?
3. **Technical Execution & Viability (20%)**
    - **Manufacturability:** Is it possible to manufacture a product created by an AI tool? How well did you make the transition from a 2D AI-generated concept to a 3D

virtual prototype? Pay attention to technical accuracy and realistic simulation of draping and fitting.

- **Workflow Integration:** Your ability to use a combination of different tools (from Midjourney/ChatGPT to CLO3D/Browzwear).

4. **Sustainability & Innovation (15%)**
   - **Measured Impact:** Have you proven that you have been able to reduce your environmental impact during this course? Demonstrate how your use of AI helped minimize physical waste (e.g., zero waste pattern cutting, digital sampling).
   - **Holistic Awareness:** Explain whether you consider trade-offs between minimizing physical waste and carbon footprint of AI operations.
5. **Critical Reflection & Ethical Judgment (20%)**
   - **Bias & Copyright Check:** Your ability to critically evaluate generated output (algorithmic biases and potential copyright issues).
   - **Critical Practice:** Provide a written or verbal explanation of your design decisions (e.g., mock client presentation). Acknowledge the limitations and boundaries of AI usage.

Portfolio Format

In this class, you will complete a Team-Based Digital Portfolio Assignment where, working in collaborative teams (just like in a modern digital design studio), you are supposed to design a collection of digital garments or develop the idea of a "Digital Twin" project.

Technical Requirements

Given the advanced digital nature of the course, participants and partnering educational institutions are expected to secure certain hardware capabilities, software resources, and network infrastructure to facilitate the completion of tasks using the proposed AI-enabled workflows.

Hardware Requirements

- **For 3D Prototyping (Local Rendering):** High-performing workstations or powerful laptops with the capability to process graphical rendering in the form of dedicated GPU

hardware and sufficient RAM capacity. Most 3D Prototyping softwares utilize NVIDIA Cuda acceleration technology GPU-Simulation and Rendering.

- **For Cloud-Based AI Tools:** Basic laptops or computers with sufficient processing power would be adequate for using web-based generative AI tools.
- **Data Storage:** Sufficient capacity of either local storage or cloud storage space required for handling large file sizes of 3D assets, renders of digital twins, and large sets of AI-generated images.

Table 1. Overall recommended configuration according to software requirements.

Operating System	Windows 11 (64-bit) or macOS 13+ (Ventura)
CPU	Intel Core i7/i9 or AMD Ryzen 7/9 (8+ cores)
RAM	8GB minimum (16GB for smooth experience)
GPU	Should support OpenGL 4.3 and have 4 GB VRAM at minimum
Storage	SSD 512 GB+ (NVMe preferred)
Display	1920×1080 minimum; 2560×1440 preferred

Software & AI Tool Ecosystem

Participants are not required to procure costly individual licenses. In order to provide equal opportunities for training irrespective of financial backgrounds and to ensure equitable access, a limited number of AI tool subscriptions will be provided for selected AI tools within the framework of the FASHIONAISE consortium.

Complementary software stacks include:

- **The Digital Atelier Hub:** Central custom-made learning platform for the current project. Participants need to register in order to access all relevant theoretical materials, asynchronous content, and assignments.

- **Generative AI & Concept Tools:** Text to image, mood board creation and pattern generation tools (examples: Midjourney, Patterned AI, Canva, ChatGPT, Weaver, The Fabricant, Pixel AI). *Note: Accessing certain tools like Midjourney requires an active Discord account.*
- **3D Prototyping & Digital Fashion CAD:** Industry standard virtual fitting and garment simulation software (examples: CLO3D, Browzwear, Style3D). Educational/student licenses for these platforms should be secured by the participants or their HEIs prior to Module 4.
- **Open Source Alternative:** Where commercial licensing options are limited, the course offers alternative open-source applications (example: Blender).

Network & Infrastructure

- **High-Speed Internet:** Due to the fact that most of the contemporary artificial intelligence agents and generative tools are cloud-based, a robust internet connection with substantial bandwidth (recommended minimum: 50 Mbps stable download/upload speeds to prevent latency during live cloud rendering and large asset transfers) becomes mandatory for both institutional studio facilities and personal student devices.
- **Unrestricted Network Access:** Partnering institutions' IT networks must guarantee full and simultaneous access to necessary AI platforms and cloud renderers within the studio session.

Shaping Sustainable Fashion: AI-Driven Innovation in Fashion Design Education

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