Final Year Project Showcase Batch-2021
For the Year 2025

Department of Textile Engineering Name of Programme: Textile Engineering		
1	**Project Idea**	(please mentioned Project Idea along with the title of the project) Development of plug-in to determine the air permeability of weft knitted structure. This project involves the development of an application using COMSOL Multiphysics® to predict the air permeability of plain weft-knitted fabric. It combines simulation modeling, application development, image analysis, and experimental validation to reduce dependency on physical prototyping and aid in performance textile design.
2	**Process**	A review of existing research on air permeability in textiles, with an emphasis on weft knitted fabric, is done to better understand the characteristics that determine permeability and how they are modeled. In this project, plain weft-knitted fabric is used to test the air permeability by using a application. A complete parametric analysis is performed to determine the fabric's specifications, which include yarn type, yarn count, fabric thickness, areal density, fiber density, wales per cm, and courses per cm. The application for calculating the air permeability of plain weft-knitted fabric is created with COMSOL Multiphysics® software. This application consists of two main modules: creating a 3D geometrical model of the plain weft-knitted fabric and the simulation of air permeability. The results obtained from the application are thoroughly evaluated. Finally, we have compared the air permeability values obtained through the experimental method with those obtained using the developed application.
3	**Outcome**	A validated COMSOL Multiphysics®-based application capable of predicting the air permeability of plain-weft knitted structure with high accuracy, reducing the need for experimental testing.
4	**Evidence (Theoretical Basis)**	The main goal of this project is to create an application using COMSOL Multiphysics® that measures the air permeability of plain weft-knitted structure. In knitted materials, air permeability is a crucial characteristic that affects comfort and functionality, especially in applications like sportswear and medical textiles. Because knitted loops behave complexly under a variety of settings, traditional approaches for estimating this parameter frequently fall short, necessitating the use of more accurate, simulation-based technologies. The air permeability of knitted fabric is greatly influenced by their distinct structural features, which include stitch length, porosity, and loop geometry. From Chamberlain's early 2D loop representations to sophisticated 3D and parametric models using spline curves and NURBS surfaces, a number of mathematical and geometric models have been put forth over time. However, real-world differences like yarn deformation and

		relaxation are frequently difficult for current models to account for. The methodology of this project integrates literature review, experimental analysis, and simulation modeling. Real fabric samples were processed to extract data including stitch density, loop length, and yarn count. In COMSOL Multiphysics®, a geometrical model of plain weft-knitted fabric was created. The airflow dynamics through the fabric were calculated by simulating this model under predetermined boundary conditions. Application Builder was used to create an application that requires little user input and automates the process from data input and 3D model construction to air permeability simulation. The principal outcomes are a high degree of correlation between the simulated air permeability values of the application and those obtained experimentally via the SDL Atlas Air Permeability Tester. Air permeability was found to be highly affected by loop length and stitch density parameters. The application was shown to be accurate within reasonable error margins and has the potential to simplify fabric testing procedures. In conclusion, the application developed provides an effective and reliable means of air permeability prediction of weft-knitted fabrics. It enables designers and engineers to simulate fabric behavior without prolonged physical prototyping, hence minimizing development time and aiding sustainability targets. Enhancements in the future can involve linking with heat and moisture transport models, application to intricate knitted structures, and the inclusion of smart fabric functionality.
5	**Competitive Advantage or Unique Selling Proposition** (Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them) Please keep relevant options, delete the rest of them, and correct the sequence	
a	**Cost reduction of existing Product**	Reduces cost by eliminating repeated lab testing and allowing faster product iteration and evaluation.
b	**Process Improvement which leads to superior product or cost reduction, efficiency improvement of the whole process** (e.g. What is the issue is current process and what improvement you suggests)	Improves testing efficiency by simulating air permeability directly from input parameters, removing manual intervention.
c	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region)	SDG 9: Industry, Innovation, and Infrastructure. The development application introduces automation and simulation in fabric testing, enhancing innovation and industrial productivity.
d	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market	Allows textile manufacturers to respond faster to market needs for breathable and sustainable fabric applications, increasing competitiveness.

e	**Capture new market (**e.g. Niche market or unaddressed segment**)**	Targets smart textile development and high-performance apparel sectors which are currently underserved by traditional air permeability testing methods.
f	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.)	Reduces carbon emissions by limiting physical prototyping and experimental trials. Promotes energy-efficient fabric evaluation.
g	**Any Other Aspect**	Supports research and development in academic and industrial settings, making it a valuable tool for textile engineering innovation.
6	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service	Textile R&D departments, academic researchers, sportswear and medical textile manufacturers, and design engineers involved in product development where air permeability is a critical parameter.
7	**Team Members (Names & Roll No.)**	Hira Ahmed TE-21006 Rabika Anum TE-21008 Alisbah TE-21018 Ribkah Sabih TE-21023
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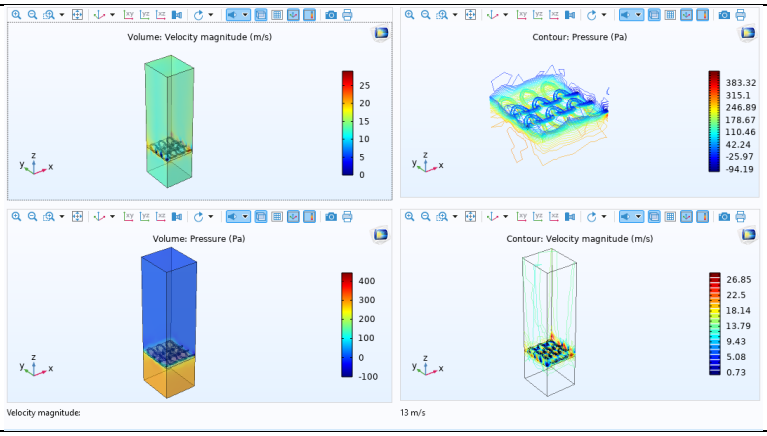
10	**Pictures (If any)**	
11	**Video (If any)**	https://drive.google.com/file/d/1Nb6T_JaZgmcWYdijD8GgV53nfDk4f4Kj/view?usp=drivesdk