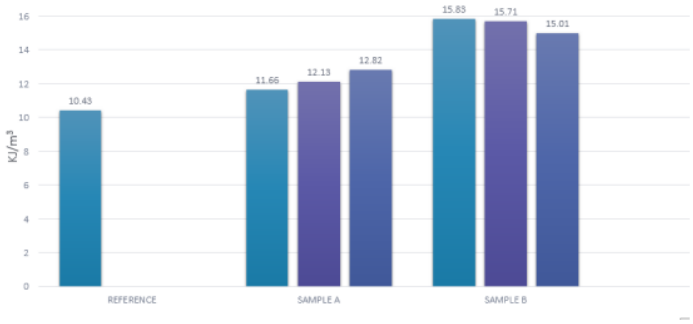
Final Year Project Showcase Batch-2018
Year 2022

Department: Materials Engineering Programme: Materials Engineering		
1	**Project Idea**	Utilization of aramid fabric, carbon fibre, and glass fibre combined with a non-Newtonian fluid (shear thickening fluid) to create a hybrid composite that enhances impact absorption for a variety of applications.
2	**Process**	• Synthesis of silica nano particles for the manufacturing of shear thickening fluid. • Infusion of shear thickening fluid into aramid fabric. • Construction of composite entailing glass fiber, carbon fiber and infused aramid fabric for enhancement in impact absorption.
3	**Outcome**	• This project assists in maintaining the composite sheet's impact absorption while also producing a locally competitive product. • Reducing the weight and keeping the costs reasonable were two crucial factors. • The sheets not only have greater impact resistance but also improved qualities that will allow us to compete with the imported product that is now in use. • In comparison to the reference sample, there is a clear 48.70% increase in the amount of energy that is absorbed during the Charpy test.
4	**Evidence (Theoretical Basis)**	The shear thickening fluid (STF) with unique rheology is generally combined with aramid fiber to manufacture flexible hybrid composites which is widely applied in impact resistance field. In this work, experiments and synthesis were comparatively analyzed to investigate the strength of the overall composite by reducing 50 % neat aramid fiber from conventional composite and replacing it with carbon and glass fiber during high-velocity impact. Optimization of materials selection is proposed to achieve a higher impact resistance performance. Shear thickening fluid impregnated aramid fabric, glass fibers, and carbon fibers are compression molded and reinforced with epoxy (LY-556). Two test specimen were fabricated specimen A with 5 aramid fabric, 3 glass fiber and 2 carbon fiber sheets and specimen B with 5 STF impregnated aramid fabric, 3 glass fiber and 2 carbon fiber sheets .Silicon dioxide (SiO_2) nanoparticles with different morphologies were synthesized through two different chemical routes. Various volume fractions of SiO_2 nanoparticles were dispersed in polyethylene glycol 200 M_w and the shear thickening behavior was investigated. This analysis also reveals that the viscosity of the fluid extensively

		depends on morphology, volume fraction and particle size distribution of the nanoparticles. The sample A and B were impact tested and fractography of sample B showed minor displacement in fibers as compared to sample A. As a result, the optimized composite B exhibits a lower peak load and 48% higher energy absorption when it was compared to sample A. According the obtained result, it is recommended that in future, the impregnated Kevlar, carbon and glass fiber based composite can be used in ballistic application by following the standard of bullet testing that contains 20-30 layers of fibers reinforced with epoxy matrix. Furthermore it is recommended to employ natural fibers in place of carbon fiber to lower the price factor even more.
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	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region)	The targeted SDG's for this project were: • **SDG#5: Gender Equality** • **SDG#8: Decent Work and Economic Growth** • **SDG#9: Industry Innovation and Infrastructure** This project caters to the demand for a lightweight hybrid composite that satisfies and modernises the criteria for impact-resistant applications and could replace and enhance the requirement provided by metallic usage. Composed and manufactured by an all women group, it furthers the cause for women empowerment as well as contributes to economic growth and sustainability.
b	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.)	Usage of carbon fiber and diminution of aramid fabric as the former is more environmentally friendly than the latter.
c	**Cost Reduction of Existing Product**	The addition of shear thickening fluid into aramid fabric decreases the number of aramid fabric used. Furthermore, an increase in the impact adsorption was observed favouring cost reduction**.**
d	**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)	For improvement in process, it is suggested to use ball-milling method to synthesize shear thickening fluid instead of sonication method. As the sonication route is time consuming and couldn't provide the required results. Further, Carbon fiber should be replaced with natural fibers that can provide the equivalent impact strength to reduce the cost of final composite. Moreover, inorder to use the composite for ballistic application, it is suggested to make a composite of 20-30 layer by adhering to the standard for bullet testing.

e	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market	The current market doesn't particularly entail locally produced impact resistant composite of adequate quality. Additionally, the demand is met by employing foreign materials. Consequently, domestically produced composite sheets employing impact resistant characteristics could increase market share
f	**Capture New Market** (e.g. Niche market or unaddressed segment)	Composites can be used in place of existing metallic applications. As a result of their superior properties, they can substitute and decrease metallic consumption.
6	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service	The aerospace, automotive, and defense industries are the targetted market where the composite was primarily produced for utilization. • Defense Industry: In the defense industry, composites can be employed in battle tank parts and bulletproof vests. • Automotive Industry: This composite can be utilized for automobile bodies and other automotive parts. • Aerospace Industry: Last but not least, it can be utilized in the aerospace industry to create a variety of airplane parts, such as wing skins, rudders, flaperons, and plane noses.
7	**Team Members** (Names along with email address)	ALIZA IRFAN alizairfan47@gmail.com AFIA SHAMIM afiashamim8585@gmail.com BUSHRA bushraiqra900@gmail.com LAIBA SHAIKH Shaikhlaiba1108@gmail.com
8	**Supervisor Name**	Dr.Muhammad Sohail Hanif msohailhanif@neduet.edu.pk
10	**Pictures**	 Fig 1 1 fractography of epoxy matrix reinforced with impregnated kevlar, glass and carbon fiber  FIG 1 2 fabricated composite  Figure 0:9 Graph For Sample Energies