NATIONAL UNIVERSITY OF TECHNOLOGY
(NUTECH)

CAPSTONE DESIGN PROJECTS (BATCH-20)

OPEN HOUSE

MECHANICAL ENGINEERING DEPARTMENT

Design & Model Fabrication of Hydrogen Electrolysis Cell for Gasoline Engine using Solar Energy

PEC Funded Project

Supervisor: Syeda Laraib Tariq

Group Members: Muhammad Bilal Arshad, Awais Tauqir, & Talha Imran

Harnessing renewable energy to produce hydrogen and using it on the spot without storing.

Key Features:

- No Hydrogen Storage Issue
- Accelerator Controlled Supply
- Safest Approach in IC Engines
- No Engine Modifications Needed

Hydrogen Is the Future:

- Zero Emissions
- Abundant Resource
- High Energy Density
- Renewable Production
- Versatility
- Most Sustainable Fuel of Future

Applications:

- Vehicles
- Stationary Power Production
- Residential Heating
- Aerospace Industry
- Maritime Transport
- Hydrogen Blending

Design and Fabrication of Exoskeleton for Human Arm

PEC Funded Project

Supervisor: Dr. Kamran Nazir

Group Members: Abdullah Shaukat, Abubakar Usmani,& Asad Ul Islam

To design and fabricate an exoskeleton for human arm to assist individuals in handling loads weighing up to 20 kg.

Working:

- The exoskeleton utilizes a powerful linear actuator controlled by an H-Bridge to assist the user's arm in lifting heavy objects.
- A wireless Remote Controller is used to operate exoskeleton.
- Safety limits (Mechanical + Electrical) ensure safe operation by preventing mechanical over-travel.

Results

- Users experienced significant reduction in physical strain while lifting heavy objects.
- The 24V 8800mAh battery provided sufficient power for extended use, effectively driving the linear actuator.
- Promising benefits for individuals' quality of life.

Applications:

- Reduces fatigue and injury risks in repetitive lifting tasks.
- Lighter than existing exoskeleton designs while maintaining high strength.
- Lay a foundation for further research in exoskeleton development. Future research areas include enhancing power, improving comfort, and expanding functionality.

Design, Modelling and Fabrication of UAV Using 3D Printing Techniques

Supervisor: Dr. Waheed Gul

Group Members: Hassan Ali, Abdul Haseeb Shah, Ashir Ali Khan

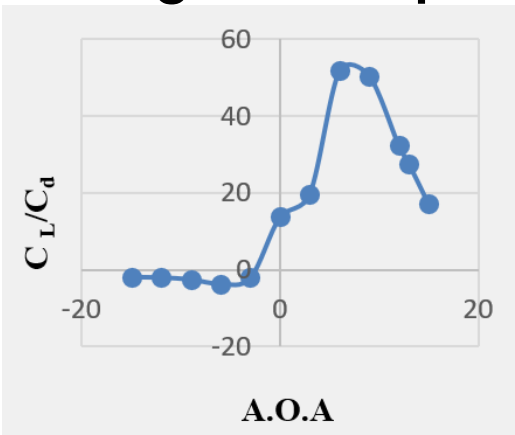
To design, model, and fabricate an Unmanned Aerial Vehicle (UAV) using 3D printing

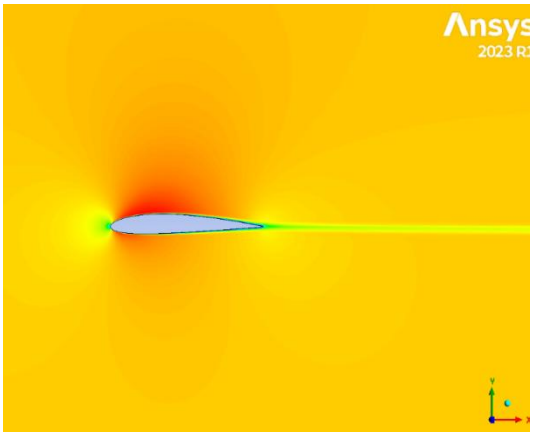
Key Features:

- Based on the mathematical modeling and different parametric study this UAV is developed for 1.2 m wing-span.
- This is tested by various tests performed practically

Results:

- Test flight was conducted at 70ft with speed of 9 m/s approx. and flight time was more than 15 mins.
- Maximum Cl/Cd value was 51 at 10 deg AOA.





Applications:

- Applications include both military and commercial domains such as:
- Surveillance
- Agriculture

Design & Model Fabrication of Hydrogen Electrolysis Cell for Gasoline Engine using Solar Energy

Project Leading to Startup

Supervisor: Sajid Raza Zaidi

Group Members: Waqar Mehdi, Mohsin Ahmed Mazari, & Talha Nadeem

HERDRIVE aims to revolutionize personal mobility in Pakistan by creating an electric tri-wheeler with a hybrid charging system. This vehicle is designed to meet the unique mobility needs of women in Pakistan, offering an affordable, sustainable, and user-friendly transportation solution. HERDRIVE seeks to empower women, providing reliable transport for commuting.

Key Features:

- Seating Capacity: 3 Persons
- Luggage Weight: 20 kg
- Motor Power: 1000 Watt
- Battery Power: 72V/34AH
- Solar Panel: 180 Watt/12V
- Top Speed: 45 km/h
- Range: 50 km

Benefits:

- Daily commute and errands.
- Safe transport in gated communities.
- Student mobility on campuses.
- Efficient transport at industrial sites.
- Urban mobility to reduce traffic & emissions.
- Promotes renewable energy use.

Applications:

- Daily commute and errands.
- Safe transport in gated communities.
- Student mobility on campuses.
- Efficient transport at industrial sites.
- Urban mobility to reduce traffic & emissions.
- Promotes renewable energy use.

Design and Model Fabrication of Solar Panel Cooling System Using Phase Change Material

Supervisor: Dr. Kamran Nazir

Group Members: Haider Ali, Najam Ul Hassan, Zain Ul Abideen

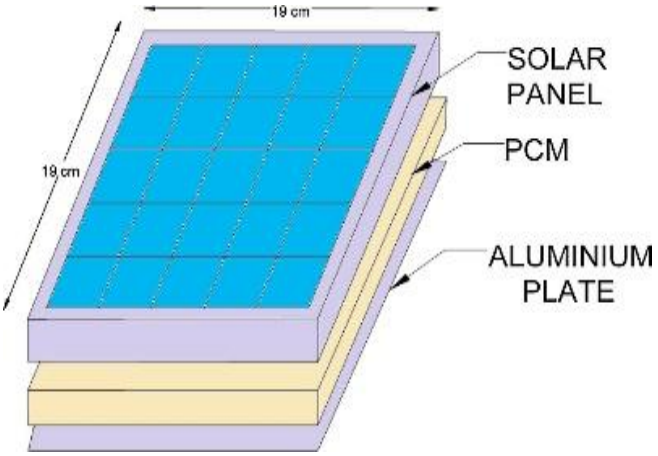
Design and Model Fabrication of Solar Panel Cooling System Using Phase Change Material.

Key Features:

- The solar panel cooling system uses a phase change material (PCM) to absorb and release heat.
- The PCM is integrated into the solar panel's backing sheet.
- During peak sun hours, the PCM melts and absorbs heat from the solar panel.
- As the temperature drops, the PCM solidifies and releases heat

Results:

- Improved efficiency: The PCM cooling system increases solar panel efficiency by up to 15%, leading to more electricity generation.
- Reduced temperature: The system keeps solar panels at a lower temperature (up to 25°C reduction), prolonging their lifespan.
- Increased energy output: The cooling system leads to a significant increase in energy output, making solar panels more effective.



Applications:

- Increased energy productivity:
- Cost savings:
- Environmental benefits:
- Reliability and durability:
- The PCM cooling system is designed for long-term reliability and durability, ensuring consistent performance over time.

Design & Model Fabrication of Hydrogen Electrolysis Cell for Gasoline Engine using Solar Energy

HIT Funded Project

Supervisor: Dr. Waheed Gul

Group Members: Usman Shehzad, Waqas Ali, Awais Ali

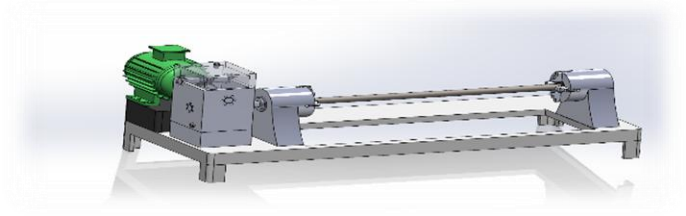
To design and fabricate an affordable and cost-effective torsional bar test bench for quality assurance.

Key Features:

- A torsional bar test bench secures the torsional bar at both ends, with one end fixed and the other connected to a rotary actuator or motor that applies a controlled torque.
- As torque is applied, sensors measure the angle of twist and the resulting shear stress. Data acquisition systems record these measurements for analysis.
- The collected data helps in evaluating the material properties, fatigue life, and performance characteristics of the torsional bar under various loading conditions.

Results:

- Experiments were conducted at different material's rods with an output speed of 0.71RPM.
- Maximum torque was shown by Steel rod followed by Aluminium and Brass rods respectively.
- Maximum twist rate was shown by Aluminium rod due to its ductile nature and less shear modulus



Applications:

- Crucial in industrial settings for quality assurance.
- Evaluating material suitability for specific applications
- Optimizing material performance and durability

Design and Fabrication of an Innovative Clamping Mechanism and Optimization of Milling Parameters for Improved GD&T

Supervisor: Lec. Sajid Raza Zaidi

Group Members: Arsal Naveed Shahzaib Ahmed, & Guffran Alam

NESCOM Funded Project

A clamping mechanism to obtain maximum flatness and roundness in thin-walled workpieces

Key Features:

- Simple and Cost effective solution for Geometric and Tolerancing issues
- Flatness improved from 50 micrometers to 5 micrometers
- Roundness improved from 45 micrometers to 3 micrometers
- Improved tolerance while keeping in mind tool's life and, wear and tear

Working:

- 8-Point Clamping mechanism distributes the clamping forces, along the circumference of the thin-walled workpiece
- Screws and Pads have been developed to aid distribution of clamping forces
- 6 N-m of torques has been applied to each of the 8 screws to secure the workpiece

Applications:

- Aerospace industries
- Precision manufacturing
- Defence Industries
- Thin wall cylinder manufacturing
- Ship industries

Design and Model Fabrication of 3D Printer Filament making machine using Waste Plastic

Supervisor: Lec. Sajid Raza Zaidi

Group Members: Farhan Yousaf, Muneeb Ahmed, Malik Muhammad Bilal & Muhammad Shakir

NIB National Winner

REBORN FILAMENT

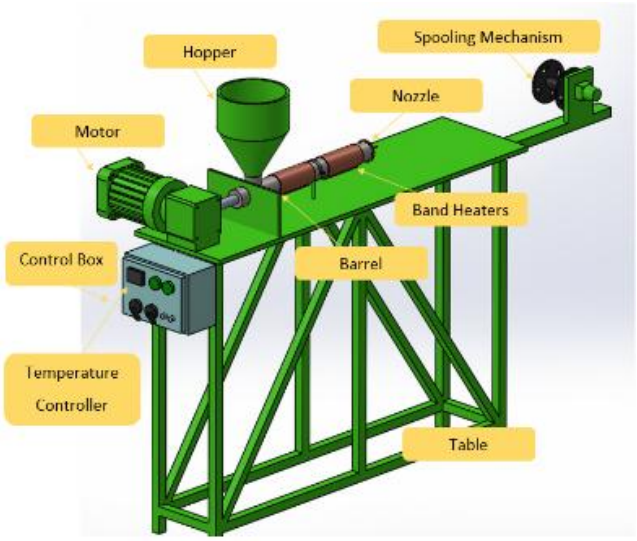
Repurposing used plastic bottles to produce 3D printer filament; reduce country's import bill

Key Features:

- Locally manufactured cost-effective filament
- Provide sustainable solution to plastic waste PET bottle
- Reduce import and promote self-developing technology
- Promote 3D printing technology.
- Leading to direct startup technology

Specification:

- Production Capacity = 1Kg / h
- Nozzle Diameter = 1.50 mm
- Motor = 0.3hp
- Maximum RPM of Motor = 40rpm
- Band Heaters = 600 W
- Heater Temperature Range = 450 °C



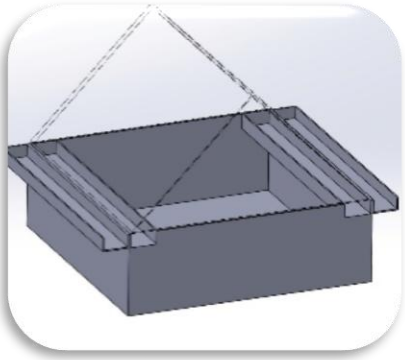
Applications:

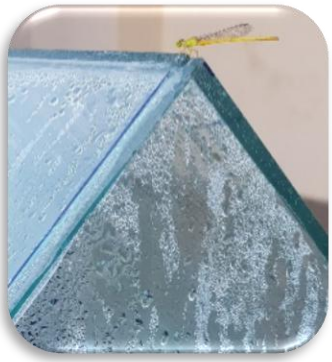
- Biomedical Industry
- Prosthetic Arms startups
- Automobile Industry
- Defense Industry
- Educational Research centers
- Prototyping centers

Design and Model Fabrication of Solar Water Desalination System

Supervisor: Lec. Ali Raza

Group Members: Hamza Munir, M. Mohsin Ashraf, Hamad Ismail & M. Adeel Nawaz Khan





Efficient power-free solar desalination system with a double slope solar still

Key Features:

- Collected approximately 2.07 liters of desalinated water in 6 hours.
- The total dissolved solids (TDS) level of the desalinated water ranged between 150-200 ppm

Working:

- The solar still captures sunlight through a transparent cover, heating the water inside the basin. The heat causes the water to evaporate, leaving impurities behind.
- The water vapor rises and condenses on the cooler surface of the cover. This is facilitated by the sloped design, which allows the condensed water droplets to flow down the cover.
- The condensed water droplets are collected into separate channels, providing clean, desalinated water ready for use

Applications & Benefits:

- Provides essential clean drinking water to remote communities and water scarcity areas
- Community-level water supply and disaster relief
- Converts saline or brackish water into clean drinking water, addressing water scarcity
- Lowers operational costs and environmental impact compared to traditional methods

Design and Fabrication of Archimedes Spiral Wind Turbine

By Gerd Simonsen

Supervisor: Lec. Engr. Basit Shafique

Group Members: Arooj Kanwal, Muhammad Arif, & Muhammad Afaq

Small Scale Archimedes Spiral Wind Turbine which gives us 25 W power

Key Features:

- At a wind speed of 4.4 m/s, the theoretical output power is 25 W.
- At a wind speed of 4.4 m/s, experimental output power is 20.97 W.
- Approximately 5 percent losses occur due to friction

Working:

- The turbine features a spiral-shaped blade arrangement, optimized to efficiently capture wind energy from various directions
- As wind flows across the spiral blades, it creates a rotational force. This rotation is transferred to a generator connected to the turbine shaft, converting mechanical energy into electrical power.
- The horizontal orientation allows the turbine to harness wind more effectively than vertical axis turbines

Applications & Benefits:

- Household power supply
- Agriculture industries
- Disaster relief
- Power supply for small electronics and lighting systems
- Off-grid power generation for remote locations

Design & Fabrication of Air Heater For Industrial & Domestic Consumers Using Solar Parabolic Trough

Supervisor: Lec. Engr. Afnan Gillani

Group Members: Abdullah Javaid, Ali Raza Abid, Muhammad Haris & Muhammad Asim

Harness Solar Energy efficiently to provide a Sustainable Air Heating Solution. Reduce reliance on conventional sources and lower harmful emissions

Key Features:

- Maximum Air temperature was observed to be 60 °C at Peak Sun Hour of 13:00.
- Simultaneously, the maximum temperature of HTF obtained was 119 °C
- The system Efficiently converted 39% of the solar radiation into useful work

Design Parameters:

- Trough length= 6 ft.
- Trough material= Stainless Steel
- Aperture length= 3.4 ft.
- Focal length= 1 ft
- Absorber Tube Material= Copper
- Heat exchanger = Radiator (Cross-Flow)

Applications & Benefits:

- Heating Domestic Household in winter.
- Annealing, Tempering, and other processes.
- Agricultural Drying, Sterilization, Textile Industry

Design and Fabrication Of Detachable Road Cleaning System

Supervisor: Dr. Muhammad Khurram

Group Members: Muhammad Huzaifa Khan Zark, Muhammad Yasir Bilal & Abdullah Nisar

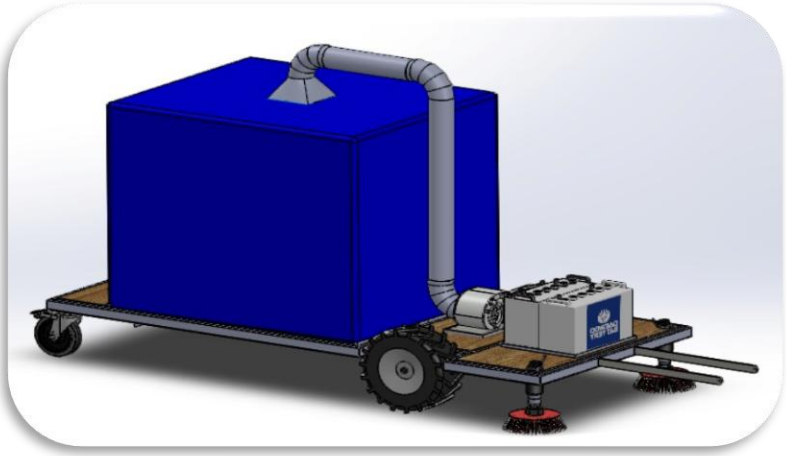
Affordable and cost-effective detachable road cleaning System. Reducing manual labor and increasing efficiency

Key Features:

- Cost-effectiveness
- Efficiency
- Environmental sustainability
- Scalability
- Adaptability
- Safety
- Easy maintenance and repair

Working:

- The Detachable Road Cleaning System, designed with a powerful 1 hp blower, efficient DC motors, a robust 3000-watt converter, and reliable 100 Ah batteries, represents a significant advancement in road maintenance Technology



Applications:

- CDA
- Housing socitites
- Universities and hospitals
- Government institutions
- Municipal Corporation