



KUMARAGURU
COLLEGE OF TECHNOLOGY



Department of Mechanical Engineering

Newsletter

MExpress

Vol. 04 Issue. 09

May 2021

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Associate Editor's Folio

ELECTRIC NAKED ROADSTER TOP SPEEDS OF UP TO 180 KPH



Mr. Nitheeshwar R K
19BME067
II Year Mechanical - B

With the boom of electric automobiles in the Indian market, e-bike makers are flexing early muscles. After 'One' electric sports bike, Efflux has teased its next upcoming model - 'Two', which was teased at its social channels. Bengaluru-based start-up had unveiled One at the 2018 Auto Expo, but it is yet to be rolled out of the production lines. Next in pipeline - Two will be introduced in two variants - standard and '+'.


The darkened front fascia teaser reveals a very aggressive silhouette like the Emflux one. It is devoid of the fairing and wind deflector which should make the Emflux TWO marginally lighter, although wind blasts are a given at higher speeds. The flat, single-piece handlebar instead of those clip-ons (of the One) will provide more comfortable ergonomics.



The other premium hardware, such as Brembo sourced brakes, Ohlin's suspension, would most likely get retained from the elder sibling. Like the Emflux ONE, the Two and Two+ are expected to have inverted front forks. Twin discs upfront and mono shock at the rear with a single disc is expected to be carried over too.

The base variant Emflux TWO claims to offer a top speed of 160 kph and the battery will offer a range of 160 km in single charge. Emflux TWO+, on the other hand, will have a top whack of 180 kph and an extended range of 200 km in single charge. Emflux has also mentioned the acceleration numbers as 4.5 and 3.6 seconds respectively, however, we are yet to know these are 0-100 kmph or 0-60 kmph sprint timings. Considering the acceleration figures of One (3 seconds), chances are that these are nought to 100 kph timings!



Departmental Activities

Programmes organized

A Technical Webinar on “Micro Manufacturing towards Digitization on 20.04.2021. **Dr. S. Balasubramanian**, ASP & **Mr. M. A. Vinayagamoorthi**, AP (II) coordinated the event. Mr. V. Sudhakar, Assistant Technical Manager, Seco Tools India Private Ltd, Mr. Sriram Nagarajan, Co-Founder and Industrial Automation Engineer, RoboRAM and Mr. S. Saravana Kumar, BusEx/OpEx Consultant & PM/AGILE/Start-ups/Grads Coach -Trainer, Chennai were the resource persons.



Faculty Training Programme on “Programming Skills” from 23-04-2021 to 23-05-2021. **Dr. V. Muthukumar**, Professor coordinated the programme. Mr. Kannan, Technical trainer, Coimbatore was the resource person.

An event “MechWiz” was conducted from 30-04-2021 to 01-05-2021. **Dr. V. R. Muruganatham**, ASP & **Mr. M. A. Vinayagamoorthi**, AP (II) coordinated the event on behalf of Mechanical Engineering Association.



Another workshop on “Introduction to Metal Additive Manufacturing and brake composites was organized from 03-04-2021 to 04-04-2021. **Dr. B. Senthilkumar**, ASP and **Dr. V. Manivel Muralidharan**, AP (II) coordinated the event.



Departmental Activities



Another event "Crazy CAD" was organized on 03-04-2021. This event was coordinated by **Mr. R. S. Mohankumar**, AP coordinated the event. Mr. Abdullah, Chief technical officer, CAD Solutions, Coimbatore was the resource person.

Faculty as Resource Persons



Dr. C. Velmurugan, Professor & HoD was the resource person in the DC Meeting conducted on 16-04-2021.

Dr. S. Balasubramanian, ASP was the resource person in the workshop on "Introduction to Metal Additive Manufacturing & Brake Composites workshop" conducted on 04-04-2021.



Dr. M. Thirumalaimuthukumar, AP (II) was the resource person in the workshop on "Introduction to Metal Additive Manufacturing & Brake Composites workshop" conducted on 04.04.2021.

Dr. P. R. Ayyappan, AP (SRG), acted as External Examiner on 21.04.2021.



Dr. S. Bhaskar, ASP was the resource Person in the following events.



1. IQAC NAAC sponsored webinar - Hindustan College of Engineering, Coimbatore - Topic - Role of teachers in imparting quality online education 09.04.2021
2. Workshop on LOCF - Day 1 - NGM College, Pollachi on 19.04.2021
3. Workshop on LOCF - Day 2 - NGM College, Pollachi on 20.04.2021
4. Workshop on LOCF - Day 3 - NGM College, Pollachi on 21.04.2021
5. Workshop on "Preparing for accreditation by NBA", Sakthi Polytechnic College, Topic - Basic Terminologies in accreditation documents on 26.04.2021
6. Workshop on "Preparing for accreditation by NBA - Sakthi Polytechnic College, Topic - Types of outcomes and principles of OBE on 28.04.2021
7. Workshop on "Preparing for accreditation by NBA - Sakthi Polytechnic College, Topic - RBT and its connection with program outcomes on 30.04.2021.

Departmental Activities

Papers Presented



Dr. M. Balaji, ASP, presented two papers entitled as given below in the International Conference on Sustainable Materials and Renewable Technologies - I-SMART 2021, conducted by Federal Institute of Science and Technology, Angamalay, Kerala which was sponsored by AICTE on 22.04.2021 and 23.04.2021

1. Balanced Score card approach in deducing Supply Chain performance
2. Augmenting Agility flow through ANP

Papers Submitted

Following faculty members submitted their papers in the various Scopus / Web of Science / SCI indexed and, in the journals listed in annexure – 1.

Name of the Faculty	No. of Papers Submitted	Scope of the Journal
Dr. B. N. Sreeharan, AP (II)	1	Scopus
Dr. S. Balasubramanian, ASP, Mr. R. S. Mohankumar, AP, Mr. M. A. Vinayagamoorthi, AP (II)	1	Scopus
Mr. S. Suresh, AP	1	Scopus
Mr. S. Rajesh, AP	1	Scopus
Mr. B. Jeeva, AP	1	Scopus
Dr. S. Thirumurugaveerakumar, ASP	1	Scopus
Dr. K. K. Arun, AP (III)	1	Scopus



Papers Published

Mr. P. D. Devan, AP, and **Dr. V. R. Muruganatham**, ASP published a paper entitled “Efficiency augmentation in the assembly section of positive displacement compressors by six sigma DMAIC method with TRIZ concept” in the Journal ‘Elementary Education Online’, Vol. 21, Issue 1, pp -1014 -1020.



Departmental Activities



Dr. S. Balasubramanian, ASP published a paper "Tribological characterization of friction stir welded dissimilar aluminum alloy AA6061 – AA5083 reinforced with CeO₂ and La₂O₃ nanoparticles" in a Scopus indexed journal.

Dr. K. K. Arun, AP (III), published a paper entitled "Machining Behaviors of Nickel Titanium Composite using Non-Traditional Machining Processes" in a Scopus indexed journal.



Papers Reviewed



Dr. P. S. Samuel Ratna Kumar, AP reviewed a paper "Thermal kinetics of SiCp reinforced Al-Zn-Mg-Cu alloy composite" for the International Journal 'Silicon'. He also reviewed another paper "A framework for Implementing Lean Manufacturing Techniques in Process Industry" for the International Journal 'Materials Today Proceedings'.

Dr. C. Velmurugan, Professor & HoD, reviewed a paper "Development of Self Compacting Concrete Using Bailey Aggregate Grading Technique in Comparison with Indian Standard Code of Practice" for the International Journal of Engineering, Design and Technology. He also reviewed another paper "Susceptibility of strain-hardening cementitious composite to curing conditions as a retrofitting material for RC beams" for the International Journal of Engineered Fibres and Fabrics.



Dr. S. Balasubramanian, ASP reviewed a paper "A Review of Deep Learning driven Computational Creativity for the Practical Demands of the Fashion Creative Design Product and Process" for the International Journal 'Textile Research'.

Dr. V. Muthukumar, Professor reviewed a paper titled "Relative Improvements in Anti Reflection Property of Black Coating Produced on Stainless Steel 310 Using Conversion Coating Techniques" Materials Today: Proceedings



Ph. D. Completed



Mr. M. Thirumalaimuthukumar, AP (II) has successfully completed the oral examination held on 22-04-2021 for the award of Doctoral degree under the Faculty of Mechanical Engineering. The Doctoral degree awarded by the Anna University Chennai is complying of UGC Regulations 2009.

Departmental Activities



Awards Applied

Dr. P. S. Samuel Ratna Kumar, AP applied for INAE Young Engineer Award.

Awards Received

Mr. M. A. Vinayamoorthi, AP (II) and **Mr. R. S. Mohankumar**, AP received the award of appreciation from the Coimbatore Productivity Council on 03.03.2021 and 15.04.2021.



Research Funds Received

Dr. N. Sangeetha, Sr. ASP and **Mr. S. Kiranlal**, AP received Rs. 1,00,00/- (Rupees One Lakh) for their proposal "SPICES" from AICTE.



Industry Linkages



Dr. M. Thirumalaimuthukumar, AP (II), co-ordinated the student placement process in Vibrant Marketing Services, Coimbatore.

Consultancy

Mr. B. Jeeva, AP provided consultancy with the help of thermal image camera for the Student project- Thermal imaging of Lithium-Ion battery system to Mr. Subash. S, Final year student Automobile department, KCT and generated Rs. 200/- and he provided the consultancy with the help of the same thermal image came for Ms. Deepadharrshini. R, Final year student, Civil Department, KCT for her project- Thermal imaging of fire bricks for ISRO project and generated Rs. 300/-.



Departmental Activities

Patent Published



Dr. K. M. Senthilkumar, ASP published his patent titled “Hi-Tech Face Mask to Detect Various Diseases” on 16-04-2021.

Online Courses / Programmes attended / participated / completed



Dr. N. Sangeetha, ASP participated in an audit course on Internal Academic Audit Training from 05-04-2021 to 16-04-2021

Dr. B. N. Sreeharan, AP (II) participated in an FDP on Essential Skills and Technologies for Quality Research from 30-03-2021 to 03-04-2021 and he also participated in another FDP on The Power of Teacher - Student Relationships in Determining Student Success from 15-03-2021 to 20-03-2021.



Dr. S. Thirumurugaveerakumar, ASP participated in an FDP on Product Design from 19-04-2021 to 24-04-2021.

Dr. T. Karuppusamy, AP (II) participated in an FDP on Design and Development of products and services from 05-04-2021 to 12-04-2021.



Dr. P. S. Samuel Ratna Kumar, AP participated in a Webinar on Applications of Electrodissolution Processes in Shaping and Finishing of Difficult to Machine Alloys on 26-04-2021. Further, he also participated in a Workshop on "Content Writing and Employment Opportunities" on 27-04-2021

Dr. P. Sathyabalan, Professor participated in a on MIC Driven activity Talk on “From your Ph.D./ Master’s Thesis to a start-up” on 23-04-2021 and on “Why IP is important in Academia” on 26-04-2021.



Departmental Activities



Mr. M. A. Vinayagamoorthi, AP II participated in a Webinar on Productivity Improvement Through SMED organized by National Productivity Council on 29-04-2021.

Mr. B. Jeeva, AP participated in a MIC Driven activity Talk on "From your Ph.D./ Master's Thesis to a start-up" on 23-04-2021 on "Why IP is important in Academia" on 26-04-2021.



Mr. S. Rajesh, AP participated in a Webinar on Applications of Electrodissolution Processes in Shaping and Finishing of Difficult to Machine Alloys" on 26-04-2021.

Dr. M. Thirumalaimuthukumar, AP II participated in a Seminar on Book Writing on 01-04-2021.



Dr. K. M. Senthilkumar, ASP participated in a Webinar on A Recent Study of Nano Material and its Implications in General on 23-04-2021.

Prof. T. R. Sukumar, ASP participated in a Webinar on Reliability analysis of work system design on 22-04-2011.



Dr. R. Manivel, Professor participated in a Webinar on Impact of Research Activities in NAAC Assessment on 30-04-2021 and, he participated in a Webinar on Hydrodynamics of Rorquals on 27-04-2021.

Internships Arranged

Dr. S. Balasubramanian, ASP arranged internships in Aavin, Coimbatore for the following students. Mr. S. Sudarshan, Mr. S. Harshit, Mr. S. Niranjan, Mr. M. Prasanth, Mr. M. Thirunavukarasar.



Departmental Activities



Dr. S. Thirumurugaveerakumar, ASP arranged internships also in Aavin, Coimbatore for the following students. Mr. S. Lingesh, Mr. D. Abishek, Mr. P. S. Pramod

MoU Signed

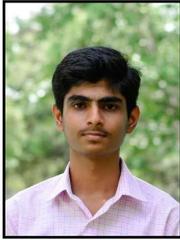


Department signed an MoU with Laghu Udyog Bharathi on 19-04-2021 for 2 Years. **Dr. S. Balasubramanian**, ASP coordinated the event.



Students Participation & Achievements

- ❖ **Mr. Prasanth M -18BME100, Mr. Praveen B -18BME092, Joshua Peter A -18BME084 & Mr. Krishnaprasad L -18BME105** of 3rd year mechanical engineering participated together a team in the **National level hackathon 'Hackerjack'** on 26-04-2021 conducted by **Bannari Amman Institute of Technology**.



- ❖ **Mr. Thibakaran. G - 20BME119** attended the webinar on **'Data analysis with python'** held on 30/04/2021 organised by My Captain.



- ❖ **Mr. Subash Raj S -(18BME111)** of 3rd year mechanical B section participated in 'Rivals' conducted by Karpagam Institute of Technology.



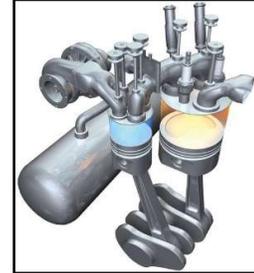
Students Articles

SPLIT CYCLE ENGINE



Mr. Nitheesh S V
6405
I Year Mechanical

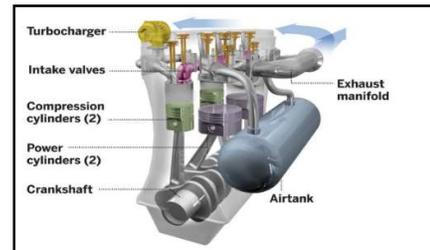
Normally, a conventional engine has its own number of cylinders. Each cylinder does four strokes per cycle, (i.e.) Intake, Compression, Power, and Exhaust. So, it requires the crankshaft to do two revolutions for each power stroke. The split-cycle engine is a type of internal combustion engine. The split cycle engine does a good work by dividing these four strokes in between two paired cylinders: Intake and Compression; Power and Exhaust.



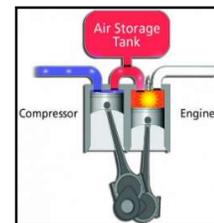
Scuderi Group has designed the latest split cycle engines, which offers a great fuel efficiency and 80 percent reduction in NO₂ emissions and 50 percent reduction in CO₂. It has two pair of cylinders, like a four-cylinder engine, so that these two pairs work together through a crossover passage. Similar as in four strokes in two groups, the left cylinder (Intake and Compression), the other (Combustion and Exhaust), The split cycle engine's air hybrid design has an air storage tank and controls by allowing it to recapture and store the energy lost, while the engine working.

These Split cycle engines were there before but still now it is not popular and has not reached the fuel efficiency of the normal conventional engines.

SwRI (The Southwest Research Institute), tested this 1-litre, two-cylinder engine nearly for a year. Those results suggests that around 30 - 36 percent, the fuel efficiency has been increased. In this air hybrid, the base model engine, increases the fuel efficiency about 25%, and it generated 135 HP at 6000 RPM, which is nearly more than like the engines which give a very less mileage.



Few split-cycle engines which were developed, already faced many practical challenges but with less performance. Those challenges were with Air flow restrictions, aerodynamics, expansion cylinder, mechanical and thermal management, late combustion of the fuel.



The main advantage of this engine is, it has an increased thermal efficiency when compared to the conventional engine. But still it has been said that, after a thermodynamical study, split cycle engines have too more efficient.

Latest news about the split cycle engine is a greater number of patents are being submitted on this engine. This shows there is more commercial interest, which will be a very needed one for this economy.

Students Articles

MECHANICAL ENGINEERING - THE INDUSTRIAL GAME CHANGER

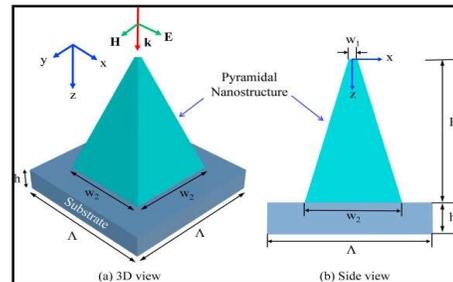


Mr. Kishore Krishna
19BME013 - II Year

Here are some of the latest mechanical engineering innovations that aim to make our lives easier.

1. An absorber design using a natural hyperbolic material for harvesting solar energy

Researchers led by Professor Ping Cheng, from Shanghai Jiao Tong University, in collaboration with Professor Zhuomin M. Zhang, from Georgia Institute of Technology, developed a perfect light absorption structure that utilizes an array of pyramidal nanostructures made of bismuth telluride (a natural hyperbolic material) over a thin substrate to absorb incident solar radiation. The study successfully presented a perfect absorber design that manipulates a periodic array of pyramidal nanostructures that are made of a natural hyperbolic material bismuth telluride on a metallic substrate. The results from the experimental procedure undertaken in this study have shown that the proposed structure can achieve absorptance values of almost 100% in the wavelength range of 300–2400 nm, upon which most of the solar radiation spectrum fall into. Altogether, the proposed metamaterial has great potential application and can lead to the effective harvesting of solar energy during photothermal conversion processes in water or aqueous solutions.

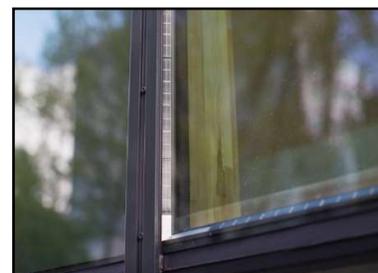


2. Windows Double as Solar Panels: fully transparent solar-power-generating windows

These windows have solar cells installed in the edges at a specific angle, which allows the incoming solar light to be efficiently transformed into electricity. The windows could generate 8 to 10 watts of power, according to Grapperhaus. "Right now, we are looking for iconic projects all over the world to show that a large glass building can be made energy neutral in an aesthetic way."

3. Acoustic Wave Separation

FloDesign Sonics, with funding from the National Science Foundation, has developed a uniquely effective patented technology called Acoustic Wave Separation (AWS) that separates or cleans water or other liquids from other contaminants. Acoustic waves were the secret behind this breakthrough technology that divorced all foreign substances such as radioactive material, hydrocarbons, bacteria, chemical additives, salt, and more, without the use of chemicals or filters.



Students Articles

THE H- FUEL - THE GAME CHANGER



Mr. KALAISELVAN P
20BME053
I Year Mechanical -B

Introduction

It is an article about Hydrogen fuel is a zero-carbon fuel burned with oxygen. As hydrogen fuel cell vehicles switch from the demonstration to commercialization, the users expect safe, comfortable, and customer-friendly fueling. It can be used in fuel cells or internal combustion engines. It has begun to be used in commercial fuel cell vehicles, such as passenger cars, and has been used in gasoline cell buses for many years. It is also used as a fuel for spacecraft propulsion

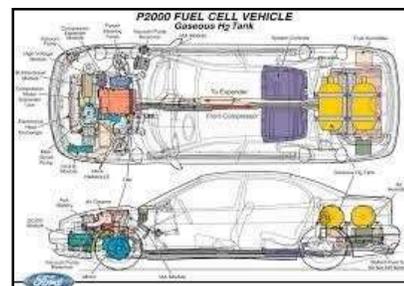


Hydrogen fuel

Hydrogen quality affects fuel cell stack performance and service life, and other considerations such as valve operation. In this paper, previous researcher's development on hydrogen as a possible main fuel of the future has been studied thoroughly. Hydrogen is one of the energy carriers which can replace fossil fuel and can be used as fuel in an internal combustion engine and as a fuel cell in vehicles. To use hydrogen as a fuel of internal combustion engine, engine design should be considered to avoid abnormal combustion. As a result, it can improve engine efficiency, power output, and decrease the NOx emissions. The emission of fuel cell is low as compared to conventional vehicles but as penalty, fuel cell vehicles need additional space and weight to install the battery and storage tank, thus increases its production cost. The production of hydrogen can be 'carbon free' only if it will be generated by employing genuinely carbon-free renewable energy sources. The acceptability of hydrogen technology is dependent on the knowledge and awareness of the hydrogen are the advantages towards environment and human life. Recent study shows that people still do not have the sufficient information of hydrogen. Hydrogen fuel cells are relatively expensive to produce, as their designs require rare substances the new technology uses durable nanowires instead of the nanoparticles. "The next step for the researchers is to scale up their results so that the technology can be implemented in hydrogen vehicles."

THE HYDROGEN CHALLENGE:

Fuel cell Source This device converts hydrogen to electric power. The challenge is to make it light, cheap, robust, and durable – yet powerful enough to run the engine, lights, and air conditioning. The future of hydrogen fuel-cell vehicles depends on advances in four key areas: the hydrogen source, the distribution infrastructure, the on-board fuel tank, and the on-board fuel cell.



Students Articles

Fuel tank:

Fuel-cell vehicles must store enough hydrogen to go several hundred kilometers between refuelling stops. Liquid hydrogen requires insulated tanks at $-253\text{ }^{\circ}\text{C}$. So, most companies have chosen to compress the hydrogen inside high strength carbon-fibre tanks. Source Hydrogen must be derived from carbon-free renewable sources before fuel-cell vehicles can make a dent in the climate problem. One idea is to make the hydrogen by splitting water using electricity from wind farms, solar panels, or nuclear plants.

Fuel cell:

Source This device converts hydrogen to electric power. The challenge is to make it light, cheap, robust, and durable – yet powerful enough to run the engine, lights, and air conditioning.

Future

A seamless transition from a petroleum-driven transportation system to clean-burning automobiles with the efficiency and range of today's gasoline cars is plausible using high-efficiency hydrogen-fueled hybrid electric vehicles. The introduction of hydrogen vehicles will reduce U.S.

Dependence on oil imports, virtually eliminate automotive urban air pollution, accelerate the development of cost-effective energy from renewable sources, and help stabilize greenhouse-gas emissions.

Based on an economic and technical analysis, H2 vehicles, when presented for the first time, can be cost-competitive with battery-powered electric vehicles. As market penetration increases, H2-vehicle fueling costs would become competitive with the fueling costs of today's gasoline vehicles. Hydrogen production at filling stations, vehicle fleets, and homes would circumvent many start-up issues and would use existing natural gas and/or electricity energy infrastructures to begin the transition towards a clean, flexible, sustainable, and secure transportation fuel.



Disadvantages:

Expensive to manufacture due the high cost of catalysts (platinum), Lack of infrastructure to support the distribution of hydrogen, A lot of the currently available fuel cell technology is in the prototype stage and not yet validated and Hydrogen is expensive to produce and not widely available.

Students Articles

THE EGR SYSTEM – ITS FUNCTION AND PURPOSE



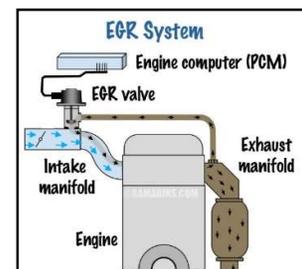
Mr. Manav R Samant
19BME006 - II Year

The internal combustion of an air-fuel mixture within an internal combustion engine is incomplete. The exhaust gas contains pollutant emissions such as Carbon monoxide (CO), Nitrogen oxides (NO_x), Hydrocarbons (HC) and Particulate matter (PM). These pollutant emissions are very harmful to human life and environment. The Nitrogen oxides forms only when there is excess of oxygen at a very high temperature inside the combustion chamber. These two conditions are only present in a diesel engine. Since the air/Oxygen is in excess in diesel engines, the Nitrogen oxide gets formed. This gas gets formed more in a diesel engine when compared to the gasoline engine. EGR Stands for **Exhaust Gas Recirculation**. This EGR system is a system in which the exhaust gases which are not burnt completely can be recirculated back to the intake manifold. This system reduces the Nitrogen oxide emission into the environment.

There are two types of EGR systems

- ❖ **Internal Exhaust Gas Re-circulation (IEGR)** is a type of EGR in which the exhaust gases are sucked back in the cylinder by overlapping the opening time of the intake and exhaust valves.
- ❖ **External Exhaust Gas Re-circulation (EGR)** is also a main type of EGR in which the exhaust gases are recirculated back into the intake manifold by using an external duct and an additional valve.

The main technology that is now being used in automobile industry is the External exhaust gas recirculation. It is more efficient than IEGR mainly because the exhaust gases can be cooled before re-entering the cylinders. The EGR system significantly reduces the amount of NO_x, but if too much exhaust gases are introduced into the intake, it can have an impact on the increase in emissions of carbon monoxide (CO), hydrocarbons (HC) and particulate matter (PM), because of incomplete combustion due to lack of air. The construction of the EGR system is given in the picture. A pipe with the EGR valve is connected to the intake manifold. The EGR valve controls and regulates the quantity of the exhaust gases. EGR valve is connected to a sensor that is connected to the brain of the vehicle. That is the PCM or the ECU of that vehicle.



The detailed construction and the parts of the EGR System are: Compressor, turbine, oxygen sensor, EGR valve, throttle, intake manifold, exhaust manifold and fuel injector.

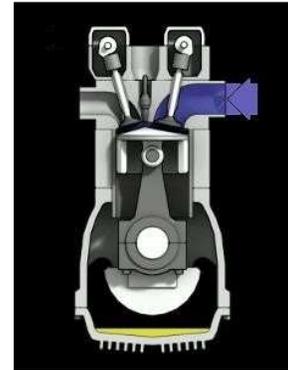
Students Articles

SALTWATER ENGINES



Mr. SARAN K
20BME103 - I Year

An engine or motor is a machine designed to convert one form of energy into mechanical energy. Heat engines convert heat into work via various thermodynamic processes. The internal combustion engine is perhaps the most common example of a heat engine, in which heat from the combustion of a fuel causes rapid pressurization of the gaseous combustion products in the combustion chamber, causing them to expand and drive a piston, which turns a crankshaft. Electric motors convert electrical energy into



mechanical motion, pneumatic motors use compressed air, and clockwork motors in wind-up toys use elastic energy. In biological systems, molecular motors, like myosin in muscles, use chemical energy to create forces and ultimately motion. The word engine derives from Old French engine, from the Latin ingenium—the root of the word ingenious. Pre-industrial weapons of war, such as catapults, trebuchets and battering rams, were called siege engines, and knowledge of how to construct them was often treated as a military secret. The word gin, as in cotton gin, is short for engine. Most mechanical devices invented during the industrial revolution were described as engines—the steam engine being a notable example. However, the original steam engines, such as those by Thomas Savery, were not mechanical engines but pumps. In this manner, a fire engine in its original form was merely a water pump, with the engine being transported to the fire by horses.

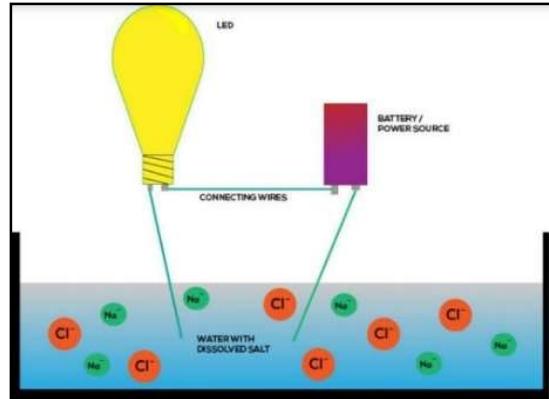
Engine Specification: The efficiency of internal combustion engines depends on several factors, the most important of which is the expansion ratio. For any heat engine the work which can be extracted from it is proportional to the difference between the starting pressure and the ending pressure during the expansion phase. Hence, increasing the starting pressure is an effective way to increase the work extracted (decreasing the ending pressure, as is done with steam turbines by exhausting into a vacuum, is likewise effective). The expansion ratio (calculated purely from the geometry of the mechanical parts) of a typical gasoline (petrol) is 10:1 (premium fuel) or 9:1 (regular fuel), with some engines reaching a ratio of 12:1 or more. The greater the expansion ratio, the more efficient the engine, in principle, and higher compression / expansion -ratio conventional engines in principle need gasoline with higher octane value, though this simplistic analysis is complicated by the difference between actual and geometric compression ratios. The efficiency of an engine is defined as ratio of the useful work done to the heat provided.

Engine Configuration: Earlier automobile engine development produced a much larger range of engines than is in common use today. Engines have ranged from 1- to 16-cylinder designs with corresponding differences in overall size, weight, engine displacement, and cylinder bores. Four cylinders and power ratings from 19 to 120 hp (14 to 90 kW) were followed in most of the models. Several three-cylinder, two-stroke-cycle models were built while most engines had straight or in-line cylinders. There were several V-type models and horizontally opposed two- and four-cylinder

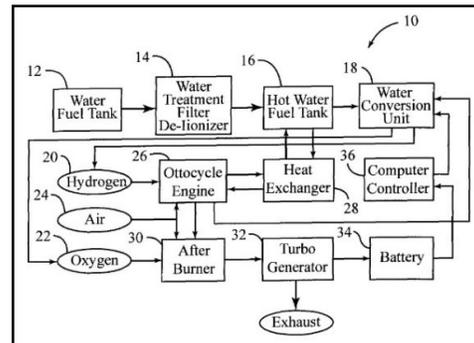
Students Articles

makes too. Overhead camshafts were frequently employed. The smaller engines were commonly air-cooled and located at the rear of the vehicle; compression ratios were relatively low. The 1970s and 1980s saw an increased interest in improved fuel economy, which caused a return to smaller V-6 and four-cylinder layouts, with as many as five valves per cylinder to improve efficiency.

Relation between salt water and current: Salt water is more dense than fresh water. This means that it has more matter per its volume. Fresh water has a density of 1 g/ml, while salty seawater has an average density of about 1.025 g/ml. Salt molecules are made of sodium ions and chlorine ions. Electrical Conductivity, electrolytes, ions, and salinity Free ions to carry a charge. The electrical conductivity of Deionized water is around 5.5 uS/cm whereas seawater is approximately 50,000 uS/cm.



Saltwater engines: So as per the saltwater engine, it works in a similar way to a hydrogen fuel cell, however, the liquid used for storing energy is saltwater. The liquid passes through a membrane in between the two tanks, creating an electric charge. This electricity is then stored and distributed by super capacitors. The salt water provides the electrolyte used in a chemical reaction inside a fuel cell. This chemical reaction creates electricity, like how a battery creates electricity. This electricity runs a small motor which powers the car. A water fueled engine, which purifies, heats and cracks water into its constituent elements in gaseous form, stores the hydrogen and oxygen separately under pressure, feeds the hydrogen to a combustion engine where it is reacted in the presence of atmospheric air, transferring the heat generated from the reaction to a water heater and torque energy to a drive shaft; an after burner that further reacts the exhaust process of the combustion engine in the presence of more atmospheric air and oxygen from the cracking process, and a turbine that drives a battery connected alternator for powering a control unit for the system, which controls all system components to ensure on demand operation.



Advantages of saltwater engines: Improves your gas mileage by up to 35%. This includes both city and highway driving conditions. Imagine how much money this would save you at the end of the month and at the end of the year. It is estimated that this could save you as much as \$897.40 per year. If you are two, three or four drivers in the family, this yearly savings increases dramatically. And what if you have a fleet of 50 drivers in your company? Then your yearly savings will multiply to \$44,870. More if you have more drivers.

Students Articles

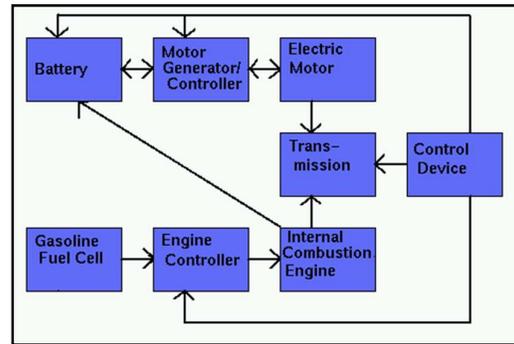
POWER FLOW IN HYBRID ELECTRIC VEHICLE



Mr. Ashwin Baalaje R
19BME069
II Year Mechanical - B

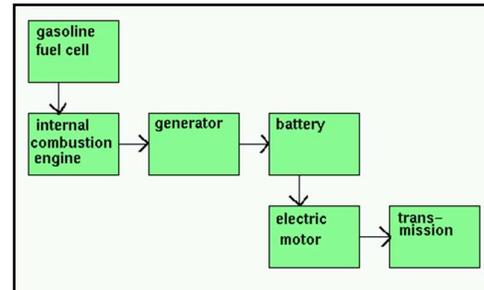
Hybrid electric vehicles consist of two geometries of power flow, i.e., Parallel and Series.

Parallel Power Flow: In this most common design, the electric motors and gasoline engine are connected in a common transmission that blends the two power sources. That transmission can be an automatic, a manual, or a continuously variable



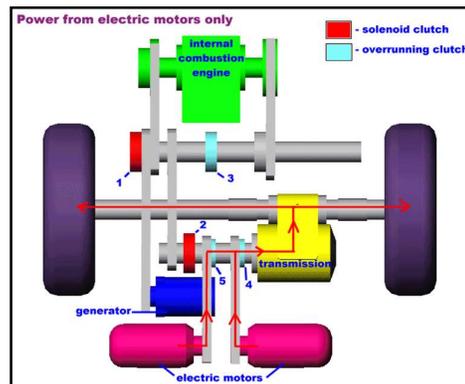
transmission (CVT). Transmission type and the size of the gasoline engine are the main factors that determine how a parallel hybrid will accelerate, sound, and feel. Brands that use the parallel design include Toyota, Lexus, Hyundai, Kia, Ford, Honda, Lincoln, Nissan, and Infinity.

Series Power flow: In this design, the electric motors provide all the thrust, and there is no physical mechanical connection between the engine and the wheels. The gasoline engine is just there to recharge the battery. This results in a driving experience that is more indicative of an electric car, with smoother, powerful acceleration. There's typically less vibration when the gasoline engine engages. However, that engagement does not always happen in concert with what your right foot is doing, so the engine might be revving up while the car is cruising at a steady speed. Some find this behavior disconcerting. The BMW i3 with the range extender is an example of a series hybrid.



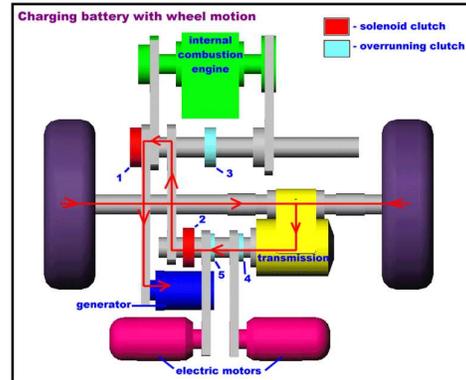
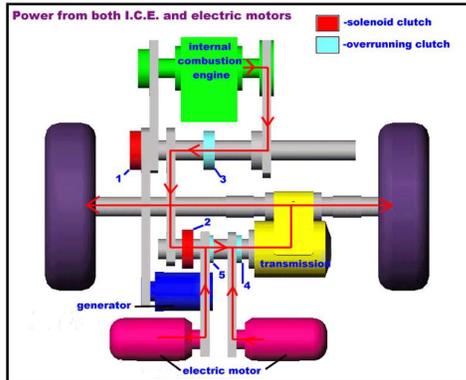
Power flow through the drive mechanism depends on the arrangement of the system and several clutches which engage and disengage components from the assembly.

Power from Electric Motors only: Power flows from both electric motors, through the transmission, and to the drive shaft and tires. Overrunning clutches 4 and 5 are engaged, all others are disengaged.



Power from Both I.C.E & Electric Motors only: Power flows from the internal combustion engine, through the secondary drive shaft, through the transmission, and then to the primary drive shaft and then to the tires. Power also flows from both electric motors to the transmission, and then to the primary drive shaft and the tires. Overrunning clutches 3, 4, and 5 are engaged and solenoid clutch 2 is engaged. All others are disengaged.

Students Articles

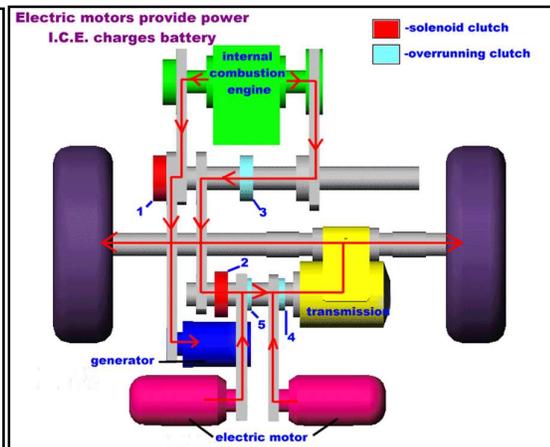
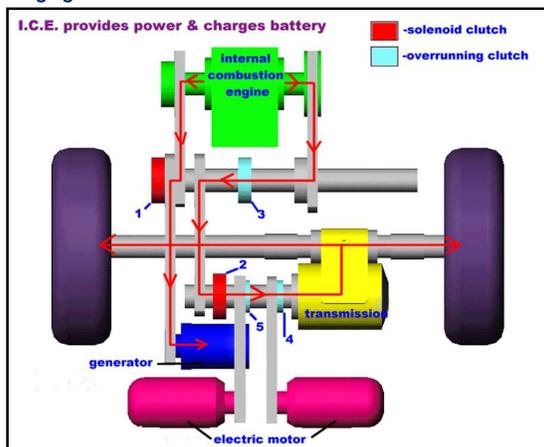


Charging battery with wheel motion: Power flows from the wheels to the primary drive shaft, then through the transmission, through the secondary drive shaft, and to the generator, and finally to the batteries. This occurs during regenerative braking. Solenoid clutches 1 and 2 are engaged, all other clutches are disengaged.

Power from I.C Engine only: Power flows from the internal combustion engine, through the secondary drive shaft to the transmission. It then flows from the transmission to the primary drive shaft, and then to the wheels. Overrunning clutches 3 and 5 are engaged, all others are disengaged. Power flows from the internal combustion engine, through the secondary drive shaft to the transmission. It then flows from the transmission to the primary drive shaft, and then to the wheels. Overrunning clutches 3 and 5 are engaged, all others are disengaged.

I.C.E provides power & Charges Battery: Power flows from the internal combustion engine, through drive shaft 2, to the transmission, and then to drive shaft 1 and the tires. Power also flows from the I.C.E., through drive shaft 2, and to the generator. Overrunning clutch 3 and solenoid clutch 1 are engaged, all others are disengaged.

Electric motors provide power & I.C.E Charges battery: Power flows from the internal combustion engine, through the secondary drive shaft, to the transmission, then through the primary drive shaft and the tires. The I.C.E. also provides power to the generator, through solenoid clutch 1, and then to the batteries. Also, the electric motors provide power to the primary drive shaft, through the transmission. All clutches are engaged.



Industry Startups

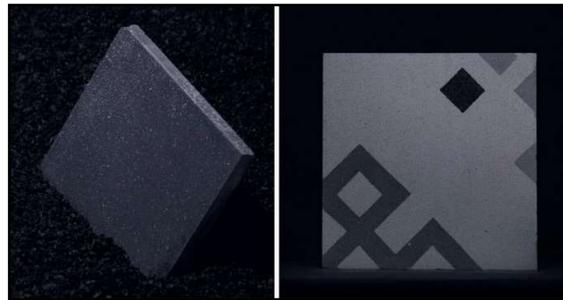
THE POLLUTION ON SKY THAT ADDS BEAUTY TO LAND



Mr. Nitheeshwar R K
19BME067 - II Year

In what is potentially a game-changer for the environment, Carbon Craft Design, a Mumbai-based design, and material start-up is harnessing air pollution to make carbon tiles. Yes, you heard that right!

The start-up, which was officially founded in January 2019, is working in collaboration with Air-In a Boston-based start-up that is processing the air pollutants and providing them with



the soot to use in their innovation. The carbon tiles come in six monochromatic shades and the start-up has 15 designs to choose from. This innovation is relevant because it is a small step towards introducing an alternative in the construction industry that accounts for almost 25 to 40 per cent of the world's carbon emissions. "Each carbon tile is equivalent to cleaning 30,000 litres of air! Moreover, these tiles consume only one-fifth of the energy required to manufacture vitrified tiles. This means, instead of burning the tiles to come up with the finished product, we use a hydraulic press that helps us in manufacturing these tiles," says Tejas Sinal, the founder of Carbon Craft Design.

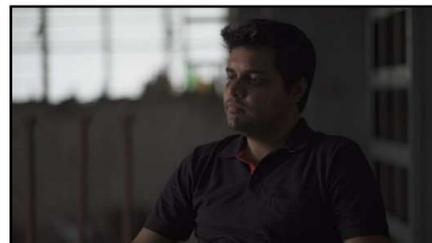
All the heavy metals and harmful components are removed from the soot, following which, traditional craftspeople in Tamil Nadu and Gujarat handcraft the tiles that come in six monochromatic shades ranging from black, four shades of grey, and white. Soot processed into powder and ready to be used to make tiles. These tiles were launched in the market in January this year, and the start-up already has three orders and will be supplying about 4000 tiles in total!



An architect, innovator, and entrepreneur Tejas has a bachelor's degree in Architecture from the University of Mumbai. As a student, he became deeply interested in biomimicry, which is a method for creating solutions to human challenges by emulating designs and ideas found in nature and wondered if it could be employed to design sustainable and environment-friendly structures.

"I stumbled upon the concept of biomimicry at a design competition in my third year of college. Since then, I began reading up on it, and during my thesis, I focussed on the subject and turned towards nature and how we can design around it," says the 32-year-old, Tejas, architect and founder of Carbon Crafts Design

Fresh out of college, he joined Ratan J Batliboi Architects, a Mumbai based architectural firm. While he was working as a junior architect, he started looking for courses that could suit his interests of biomimicry and nature focussed technical solutions.



Industry Start-ups

However, he could not find many courses that met his requirements. Finally, he secured a scholarship and got through a master's programme of his choice at the Architectural Association (AA), School of Architecture in London. Here, he graduated with a degree in Emergent Technologies and Design in 2013. He stayed in the UK for a bit and became closely involved with AA's annual architectural visiting school workshops that focussed on biomimicry, computational tools, and material systems. In May 2014, he shifted base to China where he worked for a year until June 2015 and returned to Mumbai to start providing freelance consultancy services. He was also engaged in the annual AA Breathe visiting school workshops and became the director. Air pollution from especially from the industrial sector could use this innovation to counter their emissions. In 2016, Tejas watched a video on Air-Ink and their innovation of being able to process air pollution into soot. This got him wondering if he could use his knowledge of architectural design, material systems, and biomimicry to produce a building component using it. He met with the founders and got some samples for them to start testing it. Initially, he wanted to start experimenting with making bricks. This went on for a bit, and meanwhile, he also founded a design consultancy and architectural interior research firm in July 2018 called, 'Median' with his college buddy Suraj Suthar. At one point, his experimentations to produce the carbon bricks were successful, but that idea did not see any execution.



“Although we could develop the bricks, the process of making them was expensive and time-consuming. It was not very conducive for the market,” informs Tejas.

The different powders arranged to be used in their tile designs. In December 2018, he was coordinating another AA visiting school, and here the theme was air pollution and architecture. Architecture students and practitioners came from all over the world, which led to a great deal of exchange of information. After this, Tejas realised that for a product to be accepted in the market, the product should have a design value that is lacking in the bricks. Thus, he took this idea forward and found Carbon Craft Design in January 2019. He hired a researcher and technology head to help him come up with the tile, and after countless experiments and time in the lab, they developed the carbon tile in May 2019.



Making the perfect carbon-conscious tile A craftsman hard at work Once the team at Carbon Craft Design came up with the perfect prototype, they identified traditional handcrafted cement tile producers in Tamil Nadu and Gujarat, to manufacture the tiles on a large scale, the soot is infused with materials like marble chips, marble powder, cement along with a proprietary binder. The tiles come in three sizes 8"x8", 10"x10", and 12"x12". These carbon tiles are handcrafted, produced consciously, and cost Rs. 190 per sq of the tile used. In comparison, vitrified tiles which are conventionally used, take five times more energy to produce and cost anywhere between Rs 50 and can go up to Rs 1000 per sq feet.

Industry Start-ups

Customers who are willing to buy the carbon tile can also get it customised as per their design requirements except they have to pay extra for the stencil that needs to be made especially for this purpose. The stencil can cost anywhere between Rs. 5000 and 15,000. In case they want to avoid this cost, they can go for the 15 designs that the startup also has in their portfolio. The founder with craftsmen who make these handcrafted tiles. Tejas is extremely grateful to Air-Ink and their collaboration, which allows them access to processed carbon soot—which is the basis of the work they do. **“I realised very early on that we cannot manage two tasks at hand. One being, the collection of air pollution and it is processing. We neither have the device, not the resources to process it. If we had to invest and spend time doing that, perhaps we would have never been able to come up with the tile so quickly. Hence, this association with the startup is instrumental for us,”** he says. When it came to reaching out to customers, it was not too much of a challenge for Tejas as he already had a good rapport with several people in the architecture and construction sector.

Brainstorming on different patterns: One such contact is architect Sachin Patil who runs his own independent architectural and interior design firm and came across the carbon tiles on Facebook.

“A client approached me to make a sustainable resort in Revdanda in Alibaug. When I shared the idea of using these tiles with them, they immediately hopped on board. So, we are installing them in an area measuring about 5,400 sq feet,” he shares.



Overcoming challenges and looking forward: Having come up with a unique innovation in the sphere of material design and architecture is commendable. However, Tejas has dealt with plenty of challenges in this journey. The stencils for their patterned tiles, **“To begin with, standardising the colour of the tiles is difficult to achieve because the pollution at every site won't be the same. For example, the emission will be different for each of the fuels, which means that there will be a difference in the components as well. Consequently, when it is processed, there is a variation in the colour of the powder,”** he shares. But, since these tiles are handcrafted and they are working with different monochromatic shades, they are dealing with this challenge without putting too much pressure on themselves. Another challenge that Tejas speaks about is that a lot of people do not take environmental issues too seriously. This is sometimes a hindrance to them when it comes to explaining the idea and value behind their innovation. Craftsmen handcraft these tiles using the traditional cement tile technique **“We spend a lot of time explaining our solutions and how this is a viable alternative. Since consciousness is not at its best now, we are currently functional in a market space that is not very huge or rather conducive,”** he says. However, despite these few setbacks, big companies like JSW and Larsen & Toubro are in talks with the start-up. **“They want us to collect carbon emissions from their construction sites and to manufacture tiles for them. This way, they are trying to manage the emissions they are responsible for. Eventually, we want to scale in this model where we can help large companies do that as environmental concerns are growing at large,”** explains Tejas. There are several plans that Carbon Craft Design has for the future. To begin with, they are working on establishing networks with distribution channels abroad in places like Miami, Sri Lanka, Dubai, among other places. A stack of tiles kept at their warehouse as these tiles can only be used indoors, Tejas eventually hopes to start manufacturing outdoor tiles as well, along with other architectural products like light fixtures, home accessories, furniture, among others. He also wants to make this innovation even more affordable, but that can only happen if the demand for these kinds of products grows, thus expanding the scope of the current market. **“Our ultimate vision is to be able to construct a carbon-conscious building which is made using each component derived from processing air pollutants,”** says Tejas signing off.

Biomimicry 'The Design of Nature'

THE REAL SPIDER MAN



Mr. Jayabalu S
19BME219
II Year Mechanical -

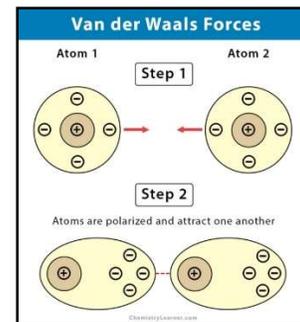
World tallest building BURJ KHALIFA. Total height of this building 829.8 meter 585 has 163 floors. Basically, Dubai has hot climate so thermal control glasses were used to build these 163 floors. But there is difficult to clean the glasses by hanging with the help of rope only. They work like stunt man. Do you think if they slip and fall, what happen to them because they were working at the height of more than 1900 feet from land? Some companies made solution to this issue by inspiring and



imitate a living organism named GECKO Lizard. GECKO lizard is a type of lizard. They easily climb the tree and wall vertically even in glass also. This lizard has ability to climb vertically even 90° and stands upside down in the ceiling of wall. Scientists research about this and find there is no frictional force or any other gums. And they found that there is a **Van der Waals force**.

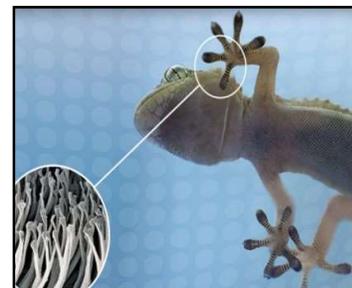
VAN DER WAALS FORCE

The electrons in atom or molecule move around the nucleus. Electrons moves very fast like a cloud during this electron spend more time on one side of the atom so one side of the electron have more electron than the other side. Basically, electron have negative charge so that the side which have more electrons have negative charge and other side have positive charge. Due to this effect the atom attracts the nearest atom. This phenomenon of attraction and repulsion is called **van der Waals force**. Mostly this occurs in every atoms and molecules.

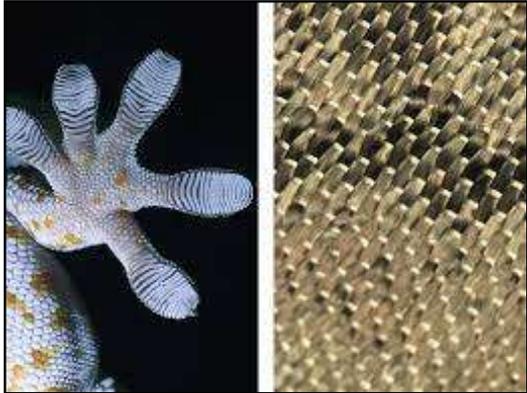


GECKO ADHESIVE SYSTEM

Van der Waals force is a force having very small amount of Attraction. So, it is not sufficient to carry the full weight of GECKO. If we touch and pressed a wall not all the surface of palm is contacted with surface of wall. But GECKO has a technique to increase its contact area. Each leg of GECKO has a lakh of hairy structured tiny nano fins called **seta**, the thickness or this seta was 5 micrometer and less diameter than our hair. Every seta tip has thousands of **spatulas**.



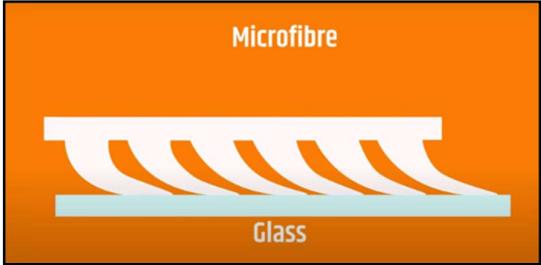
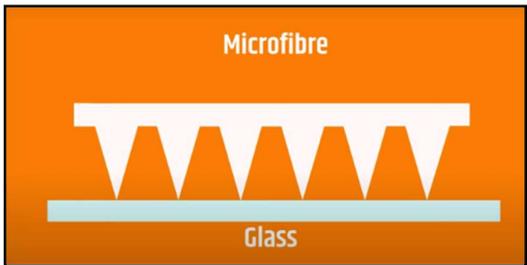
Biomimicry 'The Design of Nature'



Due to this spatula, they contacted surface and produce wand wall force. With the help of these thousands of spatulas the contact area was high. This is like sharp rubber. The edges of spatula were sharp. So, it has less contact area. But it gives stress and pressed angle so contact area was increased. Due to this high contact area high van der Waals force created. By this a single seta can lift the weight of 200 μN =20 milligram. Totally this GECKO has an ability to

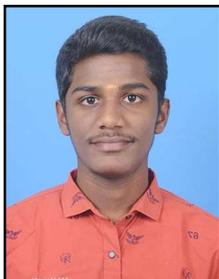
lift 133 kg.

The Engineers in Stanford University create this GECKO's adhesive property artificially. They placed a million of micro fibre like seta and attached with a spring normally this micro fibre is sharp. When the spring is moved a stress is created in this fibre tip and pressed like GECKO leg, so the contact is increased. By using this they climb glass wall like spider man. In future it was implemented without rope a man can easily climb vertical walls like spider man. NASA scientists inspired from this and created GECKO Gripper this can easily withstand weight up to 100 kg.



Reviewer's Point

ATHER 450X



Nitheesh S V
6405 - 1 Year
Mechanical

Introduction:

On the way, many of us are switching over to electric automobiles, and many would be in a confusion of choosing which one to buy. So, to clarify few things, we are going to discuss about the Electric bike, "Ather 450X", which is been manufactured by the Ather energy.



Ather 450X:

It comes in two different variants 450X plus (Rs. 1,41,683) and 450X pro (Rs. 1,60,695), and three different colours (Green, White, and Grey). Ather 450X is a flagship model of the Bengaluru based electric vehicle manufacturer, Ather Energy. This is an upgraded version of Ather 450 which was launched in 2019. Ather 450X varies in both design and in technical wise when compared to Ather 450. It has a motor with 3300 W power output. It comes from front and rear disc with Combined Braking System (CBS).

Key highlights:

The motor produces 6 kW (8.0 4bhp) of power and 26 Nm of torque. It accelerates from 0-40 kmph in 3.3 seconds and has the surety of giving a range of 85 km and covers the top speed of 80 kmph. It has the new Warp mode built on top of the upgraded battery pack and BMS (Battery Management System).



Instrument cluster:

Its instrument cluster is combined of Apron mounted headlight, Full - LED headlight, 4.2-inch touchscreen with Bluetooth connectivity, music, and call controls, integrated 4G LTE sim connectivity, digital document storage, Navigation control. It includes 1.3 GHz snapdragon processor. It has Front Telescopic Forks and Rear Mono shock absorbers. The most highlighting feature is it has the Reverse mode.



Reviewer's Point

It has charging facility with our home charger port itself and a portable charger too. It has the fast-charging facility also. It is approximate charging time is 5.45 hrs. It has a mobile charging port with a supply of 5A socket.



Specifications:

Power & Performance:

It is an electric vehicle with a PMS motor with maximum power of 6000 W and motor rated power of 3300 W, and a maximum torque of 26 Nm which is very sufficient one for a daily usage. This automatic transmission vehicle comprises a Lithium –ion battery of 2.9 kWh capacity

Brakes & basics:

It comes with front (200 mm) and rear (190 mm) discs with a Combi brake mechanism. It comes with two beautiful, designed Alloy wheels the tyres are tubeless tyres which is sized as 90/90-12. The Front calliper is 3 Piston, and the rear calliper is Single piston. It has Front telescopic forks and rear mono shock absorbers.

Dimensions and Chassis:

The chassis used here is "Precision Machined Hybrid Chassis" with an overall height of 1,250 mm and the seat height is 765 mm. It has a Decent ground clearance of 160 mm, with an overall length of 1,800 mm and width of 700 mm. The total kerb weight is 108 kg.



Features:

It has all the basic features such that, Digital odometer and speedometer and tachometer, 4.2-inch Touchscreen, Mobile connectivity, Tripmeter, GPS & navigation, Parking assist, central lock, Anti-theft system (Geo fencing), Low battery indicator, Pillion seat, footrest and Gabriel, Clock.



Company claims:

Different Ride modes, Perfect balancing, Interactive dashboards, 24 x 7 Roadside assist, Doorstep pick up & drop service, Remote diagnostics, Ather Dot- home charging point. Manufacturer gives a Battery and Motor warranty of 3 Years. They also offer 1st year Ather Service Subscription Free,

Ather bookings:

It is currently available for bookings in Ahmedabad, Bengaluru, Chennai, Coimbatore, Delhi, Hyderabad, Kochi, Kolkata, Kozhikode, Mumbai, and Pune.



KUMARAGURU college of technology

COIMBATORE – 641 049

Department of Mechanical Engineering

INSTITUTE VISION:

The vision of the college is to become a technical university of International Standards through continuous improvement.

INSTITUTE MISSION:

Kumaraguru College of Technology (KCT) is committed to providing quality Education and Training in Engineering and Technology to prepare students for life and work equipping them to contribute to the technological, economic, and social development of India. The College pursues excellence in providing training to develop a sense of professional responsibility, social and cultural awareness and set students on the path to leadership.

DEPARTMENT VISION:

To emerge as a centre, that imparts quality higher education through the programme in the field of Mechanical Engineering and to meet the changing needs of the society.

DEPARTMENT MISSION:

The department involves in sustained curricular and co-curricular activities with competent faculty through teaching and research that generates technically capable Mechanical Engineering professionals to serve the society with delight and gratification.

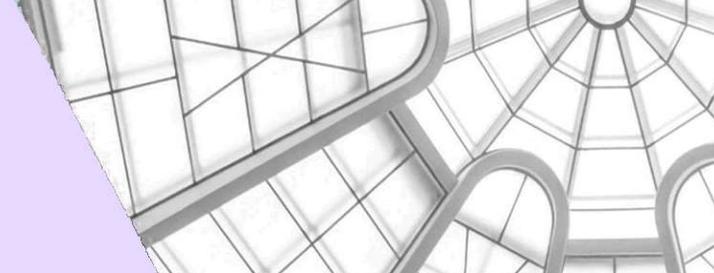
B. E. MECHANICAL ENGINEERING

PROGRAM EDUCATIONAL OUTCOMES (PEO's):

- PEO 1** : Graduates will take up career in manufacturing and design related disciplines.
- PEO 2** : Graduates will be involved in the execution of Mechanical Engineering projects.
- PEO 3** : Graduates will take up educational programme in mastering Mechanical sciences and management studies.

PROGRAM OUTCOMES (PO's):

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- 
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
 5. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
 6. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
 7. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
 8. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
 9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
 10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
 11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
 12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO's):

1. Apply the fundamentals of science and mathematics to solve complex problems in the field of design and thermal sciences.
2. Apply the concepts of production planning and industrial engineering techniques in the field of manufacturing engineering.

M. E. INDUSTRIAL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEO's):

- PEO 1 :** Graduates will be mid to higher level management / engineering professionals with responsibilities in engineering management, data analysis and business operations.
- PEO 2 :** Graduates will be engineering professionals, and technology leaders who would manage such functions as plant engineering, production, supply chain and quality management.
- PEO3 :** Graduates would function as educators or researchers in academic institutions.

PROGRAM OUTCOMES (PO's):

- P01** : An ability to independently carry out research /investigation and development work to solve practical problems.
- P02** : An ability to write and present a substantial technical report/document.
- P03** : Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PROGRAM SPECIFIC OUTCOMES (PSO's):

- PSO1** : Graduates able to apply the engineering management and data management concepts in industrial engineering areas.
- PSO2** : Graduates able to apply industrial engineering skills and knowledge to manage the functions of production and supply chain management.

M. E. CAD/CAM

PROGRAM EDUCATIONAL OBJECTIVES (PEO's):

- PEO1** : Graduates excel in Professional career and/or higher education or/ research by continuously updating the knowledge and skill in the fields of Computer Aided Design and Manufacturing.
- PEO2** : Graduates can analyze the complex problems using advanced modelling and analysis tools and thereby solve problems related to product design and manufacturing area.
- PEO3** : Graduates work individually and in a team with effective communication skills and pursue lifelong learning.

PROGRAM OUTCOMES (PO's):

- P01** : An ability to independently carry out research /investigation and development work to solve practical problems.
- P02** : An ability to write and present a substantial technical report/document.
- P03** : Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAM SPECIFIC OUTCOMES (PSO's):

- PSO1** : Graduates will be able to apply the knowledge and skill in solving the real-time problems in the Computer Aided Design and Manufacturing field.
- PSO2** : Graduates will be able to analyse complex problems and provide solutions using advanced tools in product design and manufacturing area.