Agnel Charities'
FR. C. RODRIGUES INSTITUTE OF TECHNOLOGY, VASHI

Mechanical Engineering Students Association

presents

URJA 2023-2024

BIOMIMETICS

Nature-Inspired Design and Innovation

Agnel Charities'

Fr. C. Rodrigues Institute of Technology, Vashi

Department of Mechanical Engineering

Mechanical Engineering Students' Association

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INSTITUTE PROFILE

F.C.R.I.T was established in **1994** and is a part of the Agnel Technical Education Complex at Vashi, which itself established in 1984. The institute is named after late **Rev. Fr. Conceicao Rodrigues**. F.C.R.I.T persistently seeks and adopts innovative methods to improve the quality of education on a consistent basis. The campus has a cosmopolitan atmosphere with students from all corners of the country. Experienced and learned teachers are strongly encouraged to nurture the students. The global standards set at F.C.R.I.T in the field of teaching spurs the students in relentless pursuit of excellence. In fact, it has become a way of life for all the institute. The highly motivated youngsters on the campus are a constant source of pride.

F.C.R.I.T has, within a short span of time, established itself as a leading engineering college in Mumbai University. Though its reputation rests mainly on the high quality, value based technical education that it imparts, it has to its credit a verdant, well-maintained campus and extensive facilities. Its location in the vicinity of the holy places of various religious denominations underscores it secular credentials and its philosophy of "**Vasudhaiva Kuttumbakam**".

INSITUTE VISION

To evolve and flourish as a progressive center for modern technical education, stimulating creativity in every student leading to self-sustainable professionals, through holistic development, nurtured by strength and legitimate pride of Indian values and ethics.

INSITUTE MISION

1. To provide industry-oriented quality education.
2. To provide holistic environment for overall personal development.
3. To foster relationship with other institute of repute, alumni and industry.

VISION OF DEPARTMENT

To provide a vibrant academic, research and industrial environment for creating self-sustainable professionals and responsible citizens.

MISSION OF DEPARTMENT

1. To provide state-of-the-art infrastructure and quality education.
2. To generate opportunities for students to provide Industrial Exposure.
3. To imbibe team spirit and entrepreneurial skills.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

Graduates will...

1. Be able to use effectively engineering knowledge and modern tools in the field of core Mechanical Engineering.
2. Have interdisciplinary competence in areas like Mechatronics and CAD/CAM/CAE.
3. Be able to demonstrate adequate competency and creativity to take up corporate challenges.
4. Be able to pursue higher studies and entrepreneurship

PROGRAM SPECIFIC OUTCOMES (PSO)

Graduates will be able to...

1. Apply knowledge in the domain of Design, Thermal and Manufacturing sciences to solve Engineering Problems.
2. Use appropriate tools and techniques to solve problems in the field of Mechanical Vibration and CAD/CAM/CAE.

PRINCIPAL'S MESSAGE

I intently believe that you should have an all-round development of your personality, having ambitions and aims untrammeled and hard work, enthusiasm, resilience laced with knowledge and intellect which will take you to any extent you desire. Make it a habit to read newspapers daily and ensure the optimum use of library. In today's world, professional approach towards things is necessary. Understanding the basics, relating them to real world situations and then building them into bigger things will help you to become a better engineer. Time management is another asset in the fervent stride for success.

Endeavour to be a better human being while foraying in the competitive life, realizing your dreams, honesty and integrity should be your second names. The college life provides the opportunity to develop one's personality to the fullest extent. The college magazine not only harnesses the skill of writing in the students but also inculcates the pleasure of reading among them.

- Dr. S. M. Khot
Principal

HOD'S MESSAGE

Mechanical Engineering is one of the broadest engineering disciplines, offering students a wide range of career options and always remains at the center of all technological advancements. Due to the technological advancement in the engineering field in general, the role of a mechanical engineer is changing rapidly. To meet the ever-changing requirement of the industry and sustain in today's scenario, Mechanical Engineers must have knowledge and skills in multiple domains and multidisciplinary areas to cater the needs of allied industries. There is a need for Mechanical Engineering students to cultivate ideas that allow them to be absorbed in any emerging fields. Each individual can identify the right field for their career and try to develop required skills sets expected by the industry.

I am glad that Mechanical Engineering Students Association (MESA) is doing excellent work. Every year MESA organizes events such as Synergy, MESH, Industrial Visit, URJA (annual magazine) and CALIBRE (National Level Project Competition). These events help students to get acquainted with the latest trends in industries and research. I would like to congratulate the magazine committee for selecting the right theme for Urja Magazine and publishing it.

- Dr. Nilaj Deshmukh
Dean (Faculty) and Head of Department

CO-ORDINATOR’S MESSAGE

MESA is a collegiate organization which stands for Mechanical Engineering Students Association. The objective of MESA is to create opportunities for students to enhance their knowledge about the latest developments in the technological world, by organizing various events. The MESA council of F.C.R.I.T., Vashi has ensured a continuous flow of ideas and knowledge by conducting seminars and technical events every year. These seminars give the students a sneak peak in the outside world. CALIBRE, SYNERGY and MESH are the three events conducted every year under the aegis of MESA. In SYNERGY, one industry is identified during the year and is invited to the campus for interaction. The aim is to bridge the gap between industry and institute and provide an opportunity for staff and students to directly interact with them.

During MESH, a seminar lecture series is organized in which expert speakers from industry and academia such as BARC, IIT, NIT etc. are invited to deliver lecture in their area of expertise. CALIBRE is one of the national level events in which project poster presentation is one of the events. It is organized wherein the final year students display their projects and present posters of their respective projects. Students of lower semesters get an opportunity to have a glimpse of the type of project being carried by final year students. Apart from these activities, MESA also publishes an annual magazine on various technological topics. The published articles are related to researches and inventions that many are unaware of and might be interested in. MESA continuously works for the overall development of the personality of the student other than their academic responsibilities. MESA provides wings and sky to the mind which are planning to fly high and believe in wellness in work.

- MESA Coordinators
Prof. Kamlesh Sasane & Dr. Bharat S. Kale

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ABOUT MESA

MECHANICAL ENGINEERING STUDENTS' ASSOCIATION popularly called MESA is a collegiate organization that organizes activities under the Mechanical Engineering Department. MESA is among the most active student bodies in the institute. It is mentored by experienced and proficient faculty members of the Mechanical Engineering department. Students take upon many initiatives that prepare them to face the challenge of the future. MESA aims to create opportunities for the students to enhance their knowledge about the latest developments in the ever-evolving technological world by organizing various events. Three primary events are conducted under MESA, namely SYNERGY, MESH and CALIBRE. These events provide a broader vision to the students regarding various technologies and developments happening in the professional field outside the college classrooms.

SYNERGY is conducted in every odd semester where speakers from the industry are invited to deliver lectures for Mechanical Engineering students. Similarly, MESH is conducted so that students get to know about the latest technological research advancements through researchers from IIT, NIT and BARC in every even semester. MESA also organizes its annual technical fest called CALIBRE. CALIBRE 2K23 was organized in association with "The Institution of Engineers (India), Navi Mumbai Local Centre" which had taken the initiative to inculcate creative thinking and an innovative mindset amongst the students. The event was a huge success.

Functions of MESA-

- Promoting the interests of students in various technical areas pertaining to mechanical engineering.
- Interaction between academia and industry by organizing industrial visits,special lectures, and intellectual talks.
- Interacting with other technical societies, within and outside the institute to promotethe flow of knowledge and interest.
- To allow students to learn and focus on the cutting-edge technology by presenting it tothe students in interesting manner through seminars and workshops.

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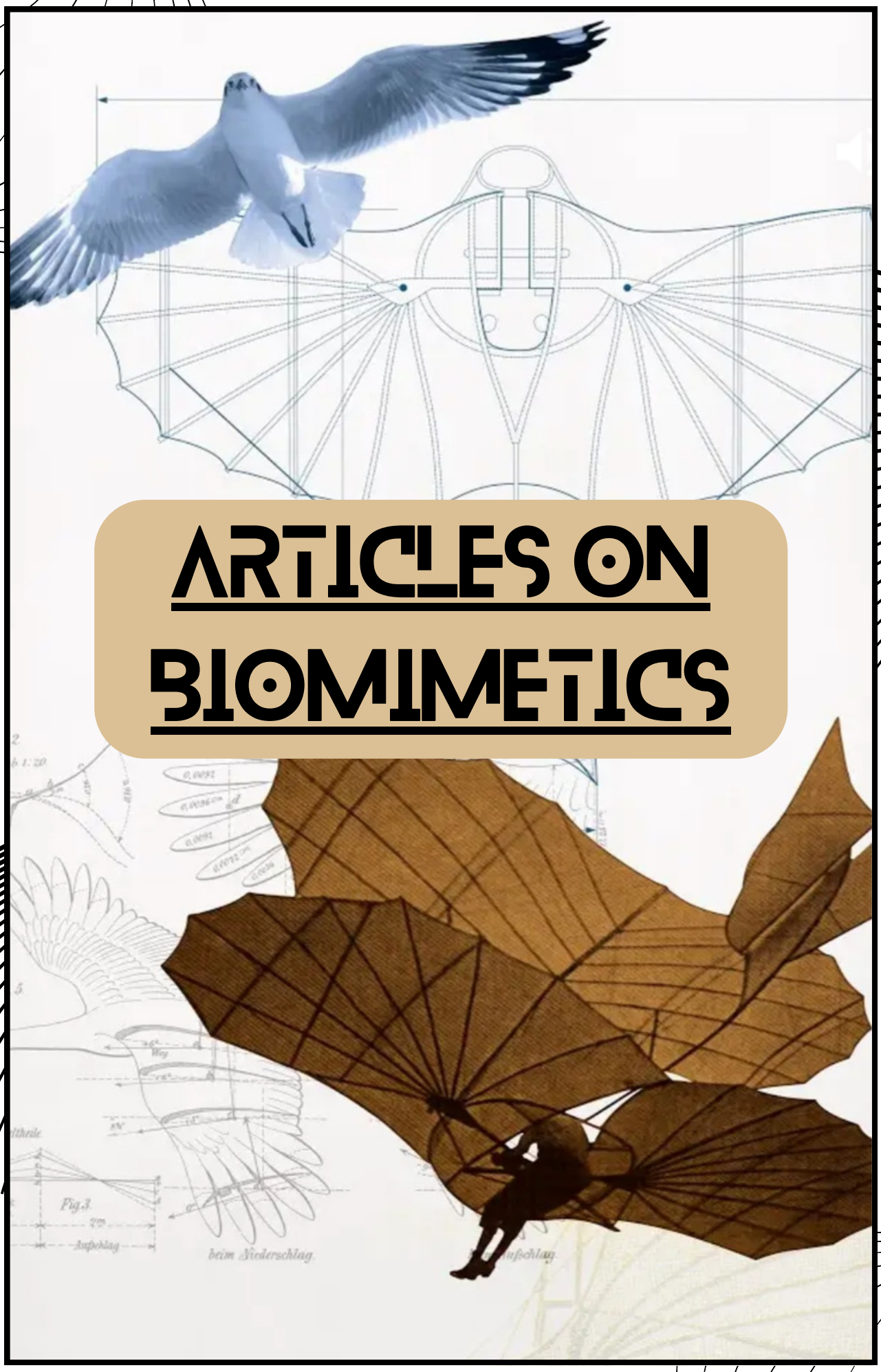

ARTICLES ON BIOMIMETICS

Impact of Biomimetics in the Field of Robotics

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Abstract*—Biomimetics involves replicating biological mechanisms and substances through artificial methods. Nature, with its billions of years of evolution, offers a treasure of efficient solutions. By mimicking these natural designs, engineering can create reliable products, reduce development costs, and enhance performance. Examples include aircraft wings inspired by birds, genetic algorithms simulating natural selection, and neuromorphic computers replicating the structure of biological neurons. Biomimetics also extends to robotics, improving locomotion by imitating animals, making robots adaptable to challenging terrains. Moreover, engineers are exploring the integration of human-like emotions in robots, not to replicate genuine feelings but to enhance their expressiveness and decision-making abilities, thereby advancing AI and automation in the future.

Keywords: Keywords—biomimetics, biological, mechanisms, mimicking,robotics, animals, locomotion, emotions, AI, automation

I. INTRODUCTION

Biomimetics is the science of imitating biological mechanisms and biologically produced substances using artificial methods. Biomimetics itself is made from two terms, 'bio' referring to mechanisms or processes that are carried out different plants and animals found in nature and 'mimicry' referring to imitation. Nature has been evolving for billions of years and has been constantly upgrading itself to changing environment. By imitating these mechanisms in the field of engineering we could design a reliable product, save on ton of iterations and hence lowering the product development cost. Here are some examples of biomimetics:

1) Aircraft wing and flight control techniques are derived from birds. In fact, the aerodynamics of the Japanese bullet train is inspired from the beak of Kingfisher [1].
2) Genetic algorithms are used in generative design to simulate natural selection to evolve solutions in iterative generations [2]. Generative design find applications in various fields of engineering like automotive, civil and aeronautics. They help optimize components, such as connecting rods, lattice patterns, taillights, and suspension systems, improving performance while reducing weight.
3) Structure and function of biological neurons is copied in order to compute and such type of electrical devices are called as neuromorphic computers.
4) Murray's law, which determines the optimum diameter of blood vessels, has been re-derived to determine the pipe diameter which gives a minimum mass engineering system.

II. BIOMIMETICS AND ROBOTICS

Biomimetics is being used in the field of robotics to develop robots that can work even in challenging environment. Locomotion of robots can be greatly enhanced by imitating various animals found in nature. Another area where imitating nature will help take robotics to great heights is copying human emotions. Emotions play an important role in decision making of humans and if future is of AI and automation then giving robots emotions will greatly enhance their capabilities.

- Locomotion of Robots

The current methods of locomotion of robots are limited to the use wheels like mecanum, omni wheel, etc. Though they offer a greater range of directional control and translational movement they cannot or are limited to operate in rough terrains. Thus locomotion mechanisms are superior to those used today as they can operate in challenging terrains and environments thus making the robot versatile. Using animal inspired locomotion

mechanisms can improve efficiency, maneuverability and adaptability. Efficiency of insects flying long distances with very little energy, adaptability of a snake to move on land, swim on water and climb on trees and the maneuverability of a cheetah to quickly and easily change directions can be incorporated in single robot if application demands so.

Here are some examples of robots using biomimetics:

1) The RoboBee, developed by scientists at Harward is a small, insect-inspired robot that can fly and hover [3]. It is powered by a tiny electric motor and uses flapping wings to generate lift.

Fig 1. RoboBee [4]

2) The Spot by Boston Dynamics is a four-legged robot inspired by quadrupeds that can carry 14kg payload capacity can carry various equipments to sense its environment and collect data where it's not possible for humans.

Fig 2. Spot®- The Agile Mobile Robot [5]

- Emotions in Robot

Emotions are defined as complex psychological states that involve three distinct components: a subjective experience, a physiological response, and a behavioral or expressive response. Humans express emotions through facial expressions, body language and tone. These expressions can be mimicked in robots using sensors and actuators. Cognitive processes associated with emotions such as attention, memory, and decision-making can be emulated using artificial intelligence. They can also be trained to learn emotions by observing and interacting with other people. It is important to note that robots cannot truly feel emotions as they are programmed to do. Despite this biomimetics is a useful tool to make robots more expressive and engaging. By understanding the biological means of emotions in humans, engineers could develop more life-like robots with apt decision making.

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Biomimetics: The inspired Art of Nature

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Abstract – Biomimicry is the science and art of emulating Nature's best biological ideas to solve human problems. The rise of interest in biomimicry in recent years has provided a fertile ground for innovation. This review provides an eco-system-based analysis of biomimicry inspired technology and product innovation. A multi-disciplinary framework has been developed to accomplish this analysis and the findings focus on the areas that have been most strikingly affected by the application of biomimicry.

Keywords: fertile ground, product innovation, recent years, biomimicry.

I INTRODUCTION

Life on Earth has evolved over billions of years, leading to highly optimized and organized structures that can inspire novel structures and designs. These adaptive structures support bending movements in beams and shell-like structures, which can be useful in aerospace technologies. Cylindrical shells are essential in aircraft fuselages, silos, and rocket stages. The application of articulating bending and aerodynamics structures is varied, including endoscopes in surgery, articulating buses, and nose cones on aircraft. This study used biomimicry of an armadillo carapace as inspiration for designing an articulating cylindrical shell and peregrine falcon as inspiration for designing subsonic flying wing

The armadillo carapace consists of alternating material segments of compliant collagen fibres and rigid bone tiles, allowing for curvature and reversible curvature. By imitating these segments, an efficient system can be built within a bending cylindrical shell, ensuring radially stiff and compliant in bending[1].

The peregrine falcon (Falco peregrinus) is one of the world's fastest birds. Nearly all bird species can alter the shape of their wings and thus can change their aerodynamic properties [2], [3], a concept known as 'morphing wing [4] During a dive, peregrines also alter the shape of their wings; while accelerating, they move them closer and closer to their body [5]. Several stages can be discriminated: up to about 190 km h the falcon shows the classical diamond shape of the wings.

II LITERATURE REVIEW

1. D Lentink et al. (April 2007) This paper focuses on effect caused due to birds adjusting their wings shape and size to improve aerodynamic performance. Analytical glide models predict that birds should adjust wing sweep to suit glide speed. A semi-empirical glide model reveals extended wings are better for slow glides and turns, while swept wings are superior for fast glides and turns. Morphing adjusts wing performance and could control future aircraft flight.
2. Shelley A. Etnier (2003) This paper investigates flexibility in 57 biological beams to identify common patterns in flexural and torsional stiffness relationships. It maps ideal and biological beams into a technoscapes, highlighting unique mechanical properties and potential applications for biology and engineering.

III APPLICATIONS

- Aeronautical applications

The Northrop Grumman B-2 Spirit, also known as the Stealth Bomber, is an American heavy strategic bomber, featuring low-observable stealth technology designed to penetrate dense anti-aircraft defenses. A subsonic flying wing with a crew of two, the plane was designed by Northrop (later Northrop Grumman). The body shape of the falcon (Falco peregrinus) during diving, helps to reach speeds over 320 km/hr. To determine flight parameters, the falcons were trained to dive in front of a 60 m vertical dam. . A life-size model was built, and drag and lift forces were measured in a wind-tunnel. Visualizations of flow in the wind-tunnel revealed local regions with flow separation, and high-resolution pictures showed feathers popping up in these regions.

Fig. 1 Comparison between falcon and B-2

Peregrines are not only extremely fast flyers but also maintain remarkable maneuverability at high speeds. For instance, high-speed stooping (aka diving) helps increase aerodynamic force, which leads to better maneuverability. When the falcon pulls back its wings and builds up speed, it minimizes the need to steer.

- Aerospace applications

Shell structures are crucial in aerospace applications, requiring articulation while maintaining a smooth surface. The hierarchical structure in the armadillo carapace inspired five designs with varying rigid tile thicknesses.

Fig. 2 Armadillo carapace

These designs were modelled using FEM, fabricated using additive manufacturing, and tested in tension, compression, and bending.

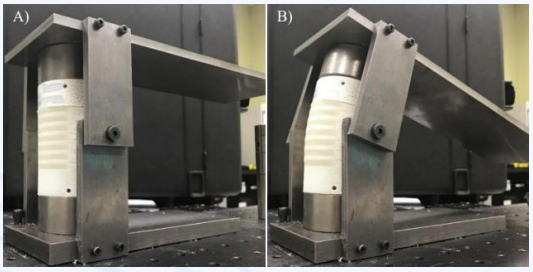

Fig. 3 Testing rig developed for bending tests shown in A) non-bending state and B) bending state.

The ringed design demonstrated higher bending stiffness, reaching 20% strain to failure in tension and 10% strain to failure in compression. This design is promising for high strain articulating cylindrical shells, and can be optimized in terms of ring shape, thickness, number of rings, and material options to meet specific applications.

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Advancement of Biomimetics in the field of Mechanical Engineering

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Abstract – Biomimetics, an interdisciplinary field combining biology, engineering, and design, aims to learn from nature's evolutionary solutions to develop advanced materials, efficient technologies, and sustainable designs. This paper provides an overview of its principles, methodologies, and applications. Humans always try to look at nature and where nature inspires solutions from nature. Biomimetics offers innovative pathways to develop advanced materials, efficient technologies, and sustainable designs. As biomimetics continues to evolve, its transformative influence across various disciplines promises a future where human ingenuity and nature's wisdom converge to shape a more harmonious and advanced world.

Keywords: ***Biomimetics, interdisciplinary, methodology, innovative, applications, evolution, influence.***

I. INTRODUCTION

The term ‘Biomimetics’ has its origin in the Greek word Bios meaning “life” and mimetics meaning “mimic”. ‘Biomimetics’ was coined by a neuro-physiologist named “Otto Schmitt”. Biomimetics, also known as biomimicry or biologically inspired design, is a field that aims to understand, emulate, and apply natural designs and strategies to address complex human challenges. The scope of biomimetics is broad, encompassing fields such as engineering, architecture, materials science, medicine, and robotics. This interdisciplinary approach involves studying the structures, processes, and behaviors of living organisms, and then applying this knowledge to create more efficient, sustainable, and adaptive designs. By learning from nature, researchers aim to not only enhance the performance of existing technologies but also to develop entirely new concepts that were previously unimaginable. There are many similar terminologies revolving around ‘Biomimetics’ namely ‘bionics’, ‘biognosis’, ‘biomimesis’, and ‘biomimicry’.

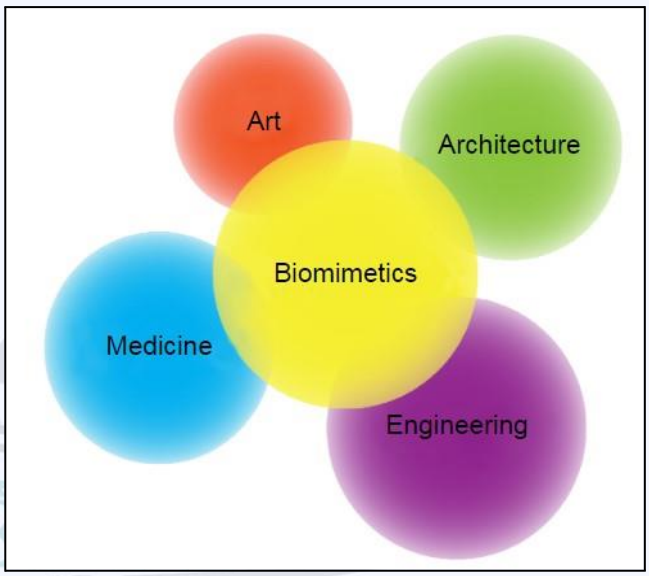

Fig. 1. The area of applications of biomimetics

II. LITERATURE REVIEW

In biomimetics, every time we need to design a new technical system we have to start afresh, trying and testing various biological systems as potential prototypes and striving to make some adapted engineered version of the biomimetic device which we are trying to create. Additionally, the transfer of a concept or mechanism from living to nonliving systems is not trivial. A simple and direct replica of the biological prototype is rarely successful, even if it is possible with current technology. Biomimetics is not a new way of adapting ideas from biology, but it is currently empirical in its approach. If it is to build on current successes, and to be able to serve our technological society, then it needs some sort of regularization, best introduced as a set of common principles[1]. In Germany, biomimetics has experienced a surge in development for about

a decade, with massive public funding for joint projects between biology and technology under the label “Bionics”, with an estimated EUR 50 million invested.[2] Studying biological systems and applying their principles to engineering problems is known as "biomimetic design." The structure of bones, for example, has influenced the development of light and robust structural components. For instance, the design of lightweight lattice structures for increased material economy in aerospace applications has been influenced by the trabecular bone structure (Gibson et al., 2010). Nature provides an abundance of materials with extraordinary qualities. Superhydrophobic coatings have been developed as a result of the self-cleaning surface of the lotus leaf, enabling applications ranging from self-cleaning surfaces to anti-icing materials (Neinhuis and Barthlott, 1997). Similar to this, high-performance synthetic materials have been developed as a result of the flexibility and strength of spider silk (Sahni et al., 2016). Aerodynamics has advanced thanks to solutions found in nature's fluid dynamics. Designing effective, low-drag airplanes and underwater vehicles has been influenced by the streamlined forms of fish and birds (Blickhan, 1989). In order to decrease drag and improve fuel efficiency in transportation, the surface features of shark skin have also been imitated (Lauder and Tytell, 2006). Advanced robotics have benefited greatly from the application of biomimetic ideas. Robots with agility and the ability to traverse challenging terrain have been developed as a result of research into animal locomotion. For instance, scientists have created legged robots that move like insects and mammals, improving mobility in difficult settings. (2013) (Kim et al.). Natural structures frequently have functions-specific designs that are optimized. Plant stem research has produced improved lattice structures with strength and flexibility that are used in infrastructure and architecture (Fraternali et al., 2013). The creation of self-healing materials in engineering has also been influenced by the adaptability of biological systems, such as the capacity of bones to heal themselves (Toohey et al., 2007).

III EXAMPLES OF BIOMIMETICS IN MECHANICAL ENGINEERING

Biomimetics has emerged as a powerful approach within the field of mechanical engineering to address complex engineering challenges. This section highlights various examples where biomimetics have been successfully applied to advance mechanical engineering.

A. *Bionic Wind Turbine Blades*: Researchers have created wind turbine blades with serrated edges that improve aerodynamic performance, inspired by the shape of humpback whale fins. Humpback whale flippers include tubercles that improve lift and decrease drag, allowing the blades to harness more wind energy while producing less noise. The efficiency and sustainability
of wind energy generation could be greatly increased by using this biomimetic strategy.

B. *Gecko-Inspired Adhesives:* Geckos are well known for their use of van der Waals forces to adhere to a variety of surfaces. Engineers have created sticky polymers that enable climbing robots and wearable devices to adhere to walls and ceilings without leaving residues or causing damage by modeling the hierarchical structure of gecko feet.

C. *Bird-Inspired flying:* Over millions of years, birds have mastered efficient flying. Researchers have designed flapping-wing drones that mimic avian flight patterns by studying the wing morphology of birds. These biomimetic drones demonstrate increased dexterity and agility by mimicking the complex wing movements and aerodynamic mechanics of birds. They may be used for surveillance, search and rescue operations, and environmental monitoring.

D. *Sharkskin-Inspired Drag Reduction:* Shark skin's rough surface served as inspiration for the creation of biomimetic materials that lessen drag in fluid flow applications. For many maritime and aerospace uses, including ships, submarines, and airplanes, engineers have developed surface textures that resemble shark denticles. This has decreased frictional drag and boosted efficiency.

E. *Plant-Inspired Morphing Structures:* Some plants, like the Venus flytrap, change shape quickly and irreversibly in reaction to their environment. These mechanisms have served as a source of inspiration for biomimetic researchers who have created morphing structures that adapt to their surroundings.

Coloration Inspired by Butterfly Wings: Rather than pigments, the rich coloration of butterfly wings results from the interaction of light with nanostructures on the wing surfaces. Engineers have reproduced these

A. nanostructures to produce structural coloration in materials, enabling brilliant colors without the use of dyes or pigments in displays, fabrics, and coatings. Vibrant hues can be achieved using this biomimetic method in a sustainable way.

IV SCOPE IN MECHANICAL ENGINEERING

Mechanical engineering's use of advances in biomimetics is extensive and constantly expanding, embracing a variety of applications and research fields. The broad range of biomimetic developments in mechanical engineering is described in this section.

1. *Materials and Structures:* Biomimetics provides light on the creation of innovative structural and material designs. The rigidity of bones and the toughness of mollusc shells are two examples of natural composite materials with extraordinary mechanical qualities that engineers are attempting to replicate. Additionally, research on the cellular architecture of plants and bones is enabling the development of strong, lightweight, and energy-absorbing structures that are used in the construction, automotive, and aerospace industries.
2. *Robotics and locomotion:* By encouraging the development of robots that can mimic animal locomotion, biomimetic concepts are revolutionizing the area of robotics. Creating legged robots that are stable and agile like animals, creating underwater vehicles that move like sea life, and creating aerial drones that fly like birds are all examples of this. The applications of biomimetic robotics include surveillance, exploration of dangerous situations, and search and rescue.
3. *Aerodynamics and Fluid Dynamics:* Developments in aerodynamics and hydrodynamics are being guided by nature's streamlined forms and fluid dynamics solutions. To create more effective ship hulls and underwater vehicles, engineers are researching the hydrodynamic characteristics of marine species. Additionally, the development of aerodynamic designs for airplanes and drones is being influenced by the theories behind the flying of birds and insects, which will help to cut fuel consumption and increase performance.
4. *Sustainable Energy Solutions:* Innovation in sustainable energy technology is being driven by biomimetics. Examples of how biomimetic strategies are assisting in the development of more effective and environmentally friendly energy solutions include solar panels that mimic plant photosynthesis, solar panels with wind turbine blades modeled after humpback whale fins, and energy-efficient ventilation systems based on termite mound structures.
5. *Medical Devices and Prosthetics:* Prosthetics and medical gadgets are being designed in a completely new way thanks to biomimetics. Insights from biological systems are being used by researchers to design prosthetic limbs that are more realistic and useful. Additionally, the creation of exoskeletons and wearable gadgets that improve mobility and rehabilitation is influenced by research into animal movement and musculoskeletal systems.
6. *Surface Textures and Coatings:* Nature's surfaces often exhibit unique textures that serve specific functions, such as self-cleaning or drag reduction. Biomimetic research has led to the creation of superhydrophobic coatings, anti-fouling surfaces, and drag-reducing materials inspired by the textures of lotus leaves, shark skin, and other natural structures. These biomimetic coatings have applications in industries ranging from automotive to aerospace.
7. *Design Optimization and Innovation:* By drawing inspiration from natural systems, biomimetics promotes a change from conventional design paradigms to creative problem-solving. It creates opportunities for novel solutions and challenges engineers to go beyond human-made ideas, resulting in innovations across a range of engineering specialties.

V CONCLUSION

The extent of biomimetic’s contributions to mechanical engineering is broad and still growing. Biomimetics provides a flexible toolkit for addressing complicated problems, ranging from materials and structures to robotics, fluid dynamics, energy, and medicinal applications. The promise for revolutionary developments in mechanical engineering through biomimetics remains optimistic as interdisciplinary

collaborations expand and academics delve further into the complexities of biological systems.

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Unveiling Nature's Blueprints: The World of Biomimetics

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Abstract – Biomimicry, a dynamic approach that draws inspiration from nature's ingenious designs and processes, is rapidly becoming a catalyst for innovative and eco-conscious solutions across global industries. Anticipated growth in the biometric technology market to a staggering $18.5 billion by 2028, according to Statista, underscores the increasing impact of biomimicry. This article delves into the pivotal role of biomimicry in driving a paradigm shift in design thinking and fostering innovation.

Keywords: Biomimetics, Sustainable products, Technologies, Global, Biometric technology market, Nature-inspired approach, Revolutionize, Design, Drive innovation, Turning to nature, Designing, Developing products, Cost-effective, Sustainable innovation

I. INTRODUCTION

The art of biomimetics revolves around imitation of life and nature's ingenuity. Nature, the cradle of life, not only nurtures and protects all living beings but also sparks extraordinary human innovation. Take, for instance, the inspiration drawn from bird flight; without it, the concept of human flight might never have taken off. This early testament to biomimetics underscores nature's profound influence on human creativity.

Today, biomimetics has evolved into a vital approach for crafting sustainable designs and solutions. It involves studying nature's strategies, forms, and processes to solve modern challenges. From self-regulating buildings that mirror ecosystems to fabrics emulating self-cleaning leaves, biomimetics is ushering in an era of innovative, eco-conscious design.

Biomimetics doesn't just replicate biological structures; it draws from nature's blueprints to revolutionize industries. The resilience of ecosystems inspires urban planning, while the efficiency of beehives translates to human collaboration. By emulating nature's time-tested solutions, we're reshaping industries and harmonizing with the environment.

In this exploration of biomimetics, we'll uncover its impact across architecture, medicine, materials science, and more. Join us as we delve into the minds fusing nature's brilliance with human ingenuity. Through these pages, you'll witness how biomimetics is not just a concept but a transformative force, guiding us towards a more sustainable future.

II THREE ESSENTIAL PRINCIPLES OF BIOMIMETICS

When translating nature’s strategies into design, the science of the practice involves three essential elements: Emulate, Ethos, and (Re)Connect. These three components are infused in every aspect of biomimicry and represent these core values at its essence.

a) Emulate

The scientific, research-based practice of learning from and then replicating nature’s forms, processes, and ecosystems to create more regenerative designs.

b) Ethos

The philosophy of understanding how life works and creating designs that continuously support and create conditions conducive to life.

c) (Re)Connect

The concept that we are nature and find value in connecting to our place on Earth as part of life’s interconnected systems. (Re)Connect as a practice encourages us to observe and spend time in nature to understand how life works so that we may have a better ethos to emulate biological strategies in our designs.

III APPLICATIONS OF BIOMIMETICS

a) Biomimetic Bullet Train Design: Kingfisher-Inspired Efficiency

Biomimetics has influenced the design of bullet trains, notably the Shinkansen. Inspired by the kingfisher bird's streamlined beak, the train's front was redesigned. This biomimetic approach reduces air pressure changes and noise when the train enters tunnels, enhancing aerodynamics, energy efficiency, and passenger comfort. Nature's blueprint has accelerated innovation on the tracks.

a) Biomimetic Swim Suit Innovation: Shark-Skin Inspired Performance

Biomimetics has revolutionized swimwear design through inspiration from shark skin. Shark scales, known as dermal denticles, have a unique texture that reduces drag in water. This led to the creation of swim suits with a fabric texture mimicking shark skin. By emulating this natural design, these swim suits offer swimmers reduced water resistance and enhanced speed. The biomimetic approach is propelling athletes through the water with efficiency borrowed from the oceans' apex predators.

b) Biomimetic Advancements in Aircraft Design: Bird-Inspired Efficiency

Biomimetics has significantly impacted aircraft design by drawing inspiration from nature, particularly birds. The structure of bird wings has inspired the development of more efficient and manoeuvrable aircraft wings. By mimicking the shape, flexibility, and feather arrangements of bird wings, engineers have crafted wings that enhance aerodynamics and fuel efficiency.

Additionally, the study of bird flocking behaviour has contributed to the development of algorithms for coordinating multiple aircraft in the sky, optimizing their paths and minimizing collision risks. This biomimetic approach not only enhances aviation efficiency but also demonstrates nature's guidance in solving complex engineering challenges.

c) Biomimetics in Robotics: Nature's Lessons for Innovation

Biomimetics has sparked transformative developments in robotics by taking cues from the natural world. Examples include:

1. Bionic Limbs: Robotic limbs mimic human and animal limbs, offering enhanced mobility and dexterity to amputees and patients with mobility impairments.
2. Gecko-Inspired Adhesives: Adhesives modelled after gecko feet allow robots to climb walls and ceilings, opening possibilities for exploration in challenging environments.
3. Fish-Like Swimming: Biomimetic fish robots replicate the undulating movements of real fish, enabling efficient underwater exploration and data collection.
4. Insect Flight: Drones modelled after insects' flight mechanisms exhibit improved agility and stability, making them ideal for surveillance and rescue missions.
5. Soft Robotics: Drawing inspiration from soft-bodied organisms, soft robots exhibit safer interactions with humans and adaptability to complex environments.
6. Swarm Robotics: By studying the coordinated behaviour of insect swarms, researchers develop algorithms for teams of robots that collaborate efficiently.
7. Biomimetic robots exemplify how nature's design principles optimize functionality and adaptability in various applications, guiding robotics toward new horizons.

IV BIOMIMETICS IMPACT ON PRODUCT DESIGN AND INNOVATION

Biomimetics has evolved into a valuable tool for crafting novel sustainable products and technologies on a global scale. Forecasts predict that the global biometric technology market will experience substantial growth by 2028. But how does this nature-inspired methodology revolutionize the realm of design and stimulate innovation?

Deriving inspiration from the natural world for product development proves both effective and cost-efficient. Moreover, biomimetics takes the concept of sustainable innovation a step further by exploring how nature's inherent blueprints can guide the construction and redesign of products that seamlessly align with environmental sustainability. This precisely why businesses

worldwide are increasingly embracing biomimetics to drive innovation, yielding eco-friendly products that stand the test of time.

Many of the challenges confronting humanity today, such as the depletion of energy reserves, have already been addressed by nature's ingenious solutions. Emulating nature's distinctive approaches to adaptation and problem-solving has the potential to yield some of the most impactful product designs. The integration of biomimetics, with its problem-solving approach inspired by nature, possesses the power to be transformative—perhaps even revolutionary—when applied with precision in the right context.

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Advances in Research for BiomimeticMaterials

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Abstract-- Smart surfaces and materials can play a significant role in intelligent, adaptive and responsive envelopes because of these intrinsic properties. The environmental question and energy efficiency in which the construction sector is involved, is in a process that can not be interrupted and that puts researchers and designers in front of a scientific and design challenge in which it is necessary to contribute to find different ways of study and experimentation on new materials and constructive languages, ranging from the application, to the structural, design and molecular, to mention the main ones. The development of technologies is helping architects of the "biomimetic current" to recreate complex structures that can be found in nature, using innovative construction methods and materials. In this paper, some existing biomimetic design strategies applied for nature emulation are presented with the aim to understand the contribution of biomimetic materials to the design culture. Case studies show the diversity of possible applications of natural phenomena in architecture with the aim to provide user-friendly tools that can facilitate the generation of more indepth insights, opening new perspectives for new possible technical solutions and showing the potential of nature adaptations to environmental conditions at different climate

Keywords- biomimetic envelope; adaptive, sustainability; smart materials; efficiency

I INTRODUCTION

The ecological approach in architecture, defined today by the increasingly severe climatic situation damaged by the strong exploitation of environmental resources and the exponential increase in pollution, is determined not only by the sum of green technologies applicable but by specific philosophical choices and a vision holistic of building which is confronted with environment. Perret states that architecture is, among all artistic expressions, the one most subject to material conditions. Permanent conditions are imposed by nature.as inspiring by natue ,nature means from animals,plants we designed various buildings and technology.this concept is known as biomimicry/biomimetic.

Adaptive behavior:In ethology, adaptive behavior is the strategy that generates the evolution of a species in response to changed environmental conditions.There is unbreakable relation between organism and environment.This is fundamental law of nature and is known as"Law of Adaptation"

II NEW BIO-INSPIRED METHODOLOGICAL-DESIGN APPROACH THE METHODOLOGY AND OBJECTIVES OF THIS PAPER CONCERN

To achieve full awareness of the problems of the environmental issues and the growing importance of sustainability and the role of the building sector in this area. . The relationship between Architecture and Nature is a driving force in the development of research lines intersecting multi-methodologies that go beyond architectural Science, the Chemistry, Nanotechnology,Ecology and Biomimetics.project and involve disciplines such as Materials.

Fig 1 - Falling water house, Pennsylvania (F.L Wright 1936)

I. The important practices was determined by focusing on the performances related to the adaptive biomimetic materials, according to environmental performance, and includes many other aspects, such as architectural and construction quality, and adaptability of space.

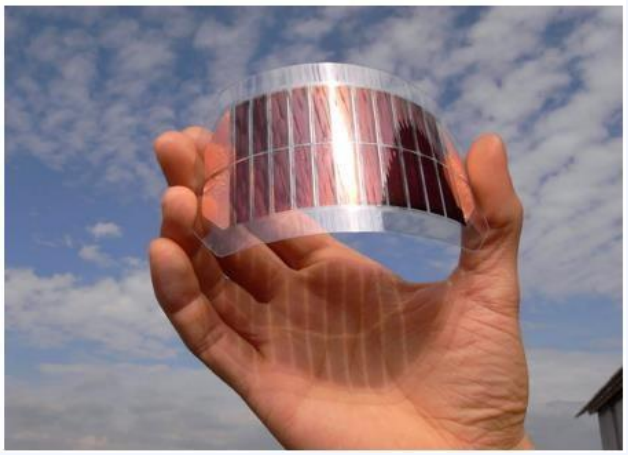

Fig 2 - Dye Sensitized Solar Cells

Performances we required is strenght point of this approach is on identifying and assessing the multiple benefits, whose many are related to energy efficiency of biomimetic solutions. Energy production. In the field of solar production and the application of fuels, technology is still at the first steps compared to the experiences of Nature. And in the field of climate adaptation we have a lot to learn from the plant world.

II. Reduction Local pollution. Energy efficiency, both supply side and end-use, can help to reduce the need for generation - and lower associated emissions -while supporting economic growth. In fact, Photocatalytic products are a contemporary innovation and play an important role in reducing pollution, thanks to their technology that allows them to be used in several cases: tiles, concrete, paint and floor coverings (Fig. 3). these materials are attracting a lot of interest throughout Europe, especially when applied to traditional surfaces because they are self- cleaning, absorb many pollutants in the air and play an antibacterial effect.

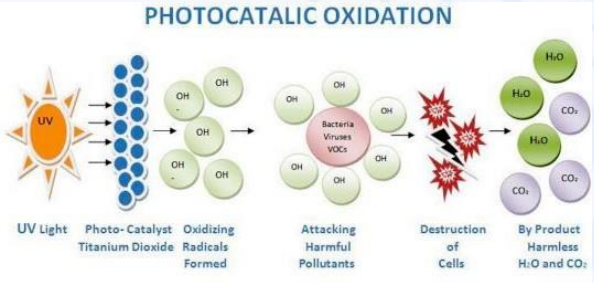

Fig 3 - Photocatalic oxidation

With help photocatal***ic oxidation we can***burned the material that are hard to decompose and this process is the combination of photo-oxidation that takes placein UV-radiation and catalytic-oxidation.

III DISCUSSION

Architects have always been inspired by nature. The evidence of this influence is still visible in buildings ranging from Egyptian or Greco-Roman architecture to Art Nouveau, to the visionary work of Frank Lloyd Wright in the XX century, creator of extraordinary buildings that integrate into the landscape (Fig. 1). Today, the development of technologies is helping architects who are inspired by biomimetics to recreate complex structures that can be found in nature, using innovative construction methods and materials. Looking at experiences in Italy or in other cities teaches us that there is no single model to apply or a good general orientation for every place, but a series of interventions, projects and attitudes can serve as a stimulus for technological solutions in other environmental contexts.

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Biomimetic Designs for Automobile Engineering

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Abstract – ***Automobile engineering often demands creative and innovative concepts to achieve their performance and efficiency targets. However, the strategies used to create these concepts are evolve with respect to time. Recently, attention has been noticed to using biomimetic concepts in the field of automobile design. The studies that apply biomimetics to automobile design often exhibit improvements in vehicle performance, vehicle dynamics and fuel efficiency. Consequently, biomimetic concepts have extended an opportunity to the automobile industry to generate futuristic designs with advanced technology. However, the innovations and inventions in biology are used in various sectors in mankind's journey .As many research communities are working on automobile engineering.***

Keywords: biomimetics; Nature-inspired; Design; Automotive; Automobile.

I INTRODUCTION

Biomimetics, in other words imitating life or inspiring from nature, is a creative form of technology that mimics nature in various developments that improve the quality of mankind's journey. Biomimetics is not a novel concept but has been used since the beginning of human inventions. In recent times, extensive engagement of biomimetics has been noticed in the development of products and behaviours in the fields ofscience. At the moment, the research community seek to develop systematic methodologies to practice biomimetic concepts in various disciplines. various designs of automobiles has ben insired from nature.

II CLASSIFICATION OF BIOMIMETIC DESIGNS IN AUTOMOBILE

Applications of biomimetics have been adopted by various fields. Therefore, the methodology proposed in Figure 1(a) was used when filtering the research that falls within the scope of this analysis. Initially, through the classification, automotive-related research based on biomimetics been selected. In the next step, biomimetics research was further narrowed down to the automobile-related applications for regular transport vehicles proceedings, and not as an independent document. Please do not revise any of the current designations.

Biomimetics in automobiles is very interesting concept in youth generations well as for research purposes too.

The Biomimetics or Biomimicry is the emulation of the models, systems and elements of nature for the purpose of solving the complex problems. Nature has gone through evolution over the 3.8 billon years since life is estimated to have appeared on Earth. It has evolved species with high performance using commonly found materials. Surfaces of interact with other surfaces ad the enviourments and derive the properties of materials. The diversity and the complexity of biological systems,the number of featuresthat might be imitated is large.Biomimetics application are at various stages of development fro technlogies that might become commercially usable to protoypes. As MURRAY's Law which is used to determine the diameter ofblood vessel,has been re-derived to find the dia (ᘐ) of pipes and tubes which gives a min mass eng. System. Finally, the research based on the micro or macro mechanical structures was selected, excluding the research based on behaviours of the biological organisms. Here, macro-level biomimetic designs have been categorised further into three clusters. The basis of this classification was the sub-system of the automobile i.e body, wheel assembly, powertrain ,enginesefficienies , under-the-hood, which embraced the biomimetic design, see Figure 1(a).

Microstructural mimicry, on the other hand, provides materials with enhanced propertie like enchancing the mechanical as well as chemical properties of the respectivematerial using in auto mobiles . During the analysis, thesematerials were identified in several automobilerelated applications. They were adding futuristic features to the automobiles such as self-cleaning, self-healing, scratchresistance,, and lubrication, see Figure 1(c). A summary ofthe identified literature on biomimetic macro and microstructures is illustrated in Figure 1(b) and 1(c).

As there are plenty of eg.of biomimetics in other sectors of Engineering too.

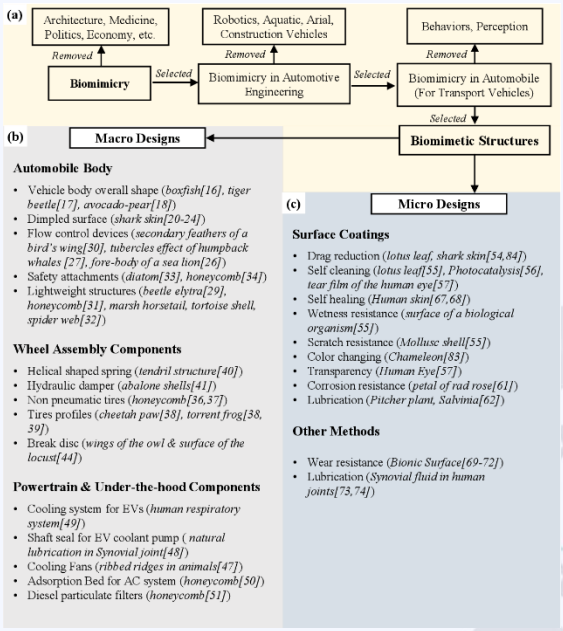

Fig 1. Classification of Biomimetic Designs used in Automobile Developments

Biomimetic developments for automobile body Since the mid of 19th century, several automobile producers have used animal appearances for their models. They have also used the mimicked animal name as the model name. These include the Ford Mustang, AMC Marlin, Shelby Cobra, Plymouth Barracuda, Chevrolet Cheetah, and Volkswagen Beetle [14] (see Figure 2). Initially, the main expectation of using nature-inspired shapes was to develop low aerodynamic drag in automobiles. Consequently, this approach has also enhanced customer attraction. For example, Hou et al. [15] explain how animal-inspired shapes and their names can physiologically influence automobile users.

Fig 2. Animal Inspired shapes for Automobiles

A. More recently, the Mercedes-Benz company has introduced a vehicle named bionics car , which had a shape that was inspired by a boxfish, . This shape has proven to have an extremely low drag coefficient. In another attempt, Peng et al. [17] managed to design a low-drag automobile using the shape of a tiger beetle,. With this imitation, the design has specifically reduced the after-body drag. Another example of this is the avocado- pear-inspired vehicle design introduced by Agyeiet al. [18]. These developments imply that the bionics concept is expected as the foundation of future automobile design [19]. On the other hand,the drag resistance on the vehicle can be reducedby changing the texture of the external surface ofthe automobile body. In the classical engineeringmindset, it is believed that smooth surfaces are associated with streamlined flow and low drag. However, in nature, the creatures that fly or swimare, for the most part covered with feathers or scales and possess a surface texture that varies infrequency and amplitude. For instance, the scales present in the microstructure of the shark's skin isdepicted

B. The macro-structural design solutions in this section include the biomimetic implications on the overall structure of the vehicle. It also discusses biomimetic components in automobile sub-systems such as wheel assembly, powertrain, steering, and air conditioning. Authors andAffiliations

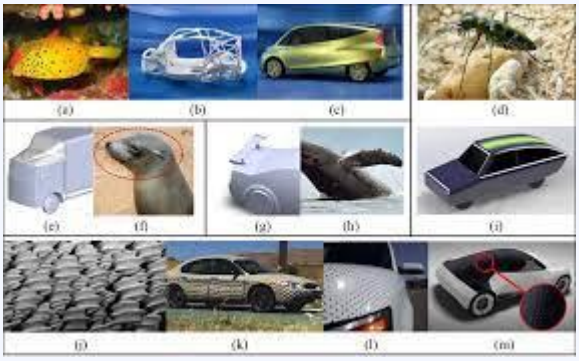

Fig 3. Biomimetic macro scale designs for aerodynamics improvement

A. Design Approaches and Future Direction: Biomimicry based engineering design can be performed in two different approaches i.e (i) Top to Bottom Approach and (ii) Bottom to Top Approach which is mentioned in Fig 3.

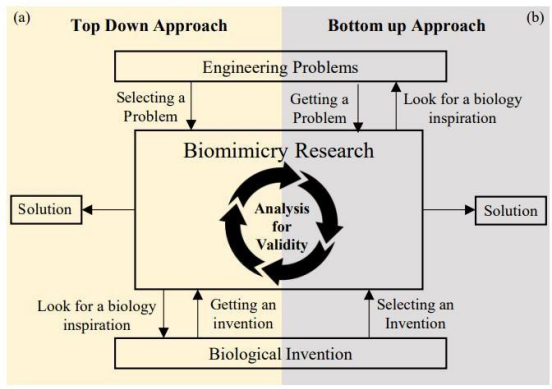

Fig 4. Types of Approach

III CONCLUSION

This article provides classifications for the biomimetic research on automobiles in the defined scope. The classification highlights the biomimetic research on automobile engineering under two clusters: macroscale structures and microscale structures. So far, macroscale biomimetic structures have invaded automobile body, wheel assembly, powertrain and under-the-hood components. The microscale research was predominantly used to enhance the surface properties, lubrication and wear resistance. These developments are involved in increasing the performance of the vehicle, improving the fuel economy and incorporating additional features such as self-cleaning, self-healing, and wear resistance to future automobiles.

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Train Crafted with Bird Traits in Mind

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***Abstract** – Artists, designers, and engineers have long drawn inspiration from the natural world. Avian species, which have evolved a variety of extraordinary qualities through millions of years of adaptation, are one interesting area of nature's creations. The fascinating world of bird features and their application to the fields of art and engineering is explored in the following article. Avian adaptations provide a multitude of ideas that can be used to improve the creativity and functionality of human creations, from the aerodynamic miracle of bird flight to the intricate details of their brilliant plumage. The form, color, and symbolism of birds have been used by artists to convey deeper meanings in works that are both aesthetically striking and emotionally stirring. In addition, engineers have begun to employ biomimicry, a design strategy that draws inspiration from nature, to come up with original answers to difficult problems. The Shinkansen Bullet Train's streamlined and elegant appearance, which has transformed high-speed rail travel, was inspired by the aviation industry. This article examines the aviation-inspired aerodynamics that have significantly influenced the Shinkansen's unique design and performance.*

***Keywords:** biomimicry, avian, shinkansen, aerodynamics.*

I. INTRODUCTION

The Shinkansen, often known as the Bullet Train, is a legendary illustration of human engineering prowess. The Shinkansen has changed the way we think about and experience travel, and this article explores its history, design principles, and societal repercussions. The Shinkansen was created in Japan after World War II as a solution to the country's need for reliable, quick, and efficient transportation. The article examines the creative technical approaches that made it possible for the Shinkansen to travel at such remarkable speeds, including developments in rail design, propulsion systems, and aerodynamics. The Shinkansen gained its recognizable streamlined appearance by exploring the design concept of prioritizing passengers' comfort, safety, and speed. The Shinkansen also had an impact on design aesthetics and culture. A fresh direction for industrial design has been created by the design's successful integration of form and function, which has spread to other forms of transportation and even consumer goods. Its modern, cutting- edge design has come as a symbol of innovation and progress. The Shinkansen is inspired by kingfisher, owl and penguin birds. The kingfisher bird is a living example of how well nature has mastered aerodynamics because of its amazing capacity to descend smoothly from the air into water to capture prey. The remarkable aerodynamic adaptations of the kingfisher are explored in this article along with how they have sparked advancements in engineering and design. Engineers and scientists have drawn inspiration from the kingfisher's flight prowess to develop efficient designs for modern technology.

II. HISTORY

The history of the Shinkansen, Japan's high-speed bullet train, is a remarkable journey of innovation, modernization, and technological excellence. Here is an overview of the key milestones in the history of the Shinkansen:

After World War II, Japan's transportation system encountered difficulties. A vision for a contemporary, effective, and high-speed rail network was sparked by clogged roads, outdated rail systems, and the rise of the vehicle. The Tokyo-Kawasaki Line (known as the Hachiko Line) served as an experimental platform for testing high- speed train technology, reaching speeds up to 145 km/h (90 mph) and laying the groundwork for the Shinkansen.

First Generation was with a top speed of 210 km/h (130 mph), the first Shinkansen, also referred to as the "0 Series," significantly decreased the amount of time it took to travel between Tokyo and Osaka.

III NEED

The need for the Shinkansen arose from various factors that converged to reshape Japan's transportation landscape.

- Post-World War II Reconstruction: After World War II, Japan's economy and infrastructure were in ruins. There wasa pressing need to modernize the country's transportation system to support economic recovery and growth.
- Increasing Congestion: The existing rail network in Japanwas facing issues of congestion and inefficiency. The conventional trains were slower and couldn't cope with the growing demand for transportation.
- Automobile Dominance: The rise of the automobile industry led to an increased focus on road infrastructure, which shifted passenger and freight traffic from railways to roads. To maintain a balanced transportation system, railways needed to offer a competitive alternative.
- Tokaido Main Line: The Tokaido Main Line, connectingTokyo and Osaka, was the most congested and crucial rail route in Japan. The need for a faster, more efficient, and higher-capacity rail link between these two major cities became evident.
- 1964 Tokyo Olympics: Japan's hosting of the 1964 Summer Olympics provided an incentive to showcase technological prowess. A high-speed train system could symbolize Japan's progress and modernity to the world

IV MODIFICATIONS IN THE TRAIN

Thirty years ago, Japan’s famous bullet train had a problem, when it travelled through tunnels it made a loud noise. It was very disturbing to surrounding areas, wild life and birds. As the air was building in front of the train as it entered a tunnel, the compressed air created a sound wave and as this left the tunnel loud noise was heard. A sound was like a gunshot came out. Due to this aerodynamics the air was slowing the train down like wading through water.

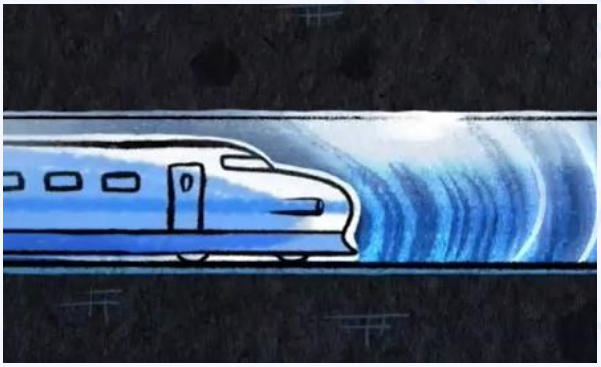

Figure 1 Air building in front of train

Figure 2 Kingfisher Bird

The kingfisher bird’s long, sharp, pointed bill is perfectly shaped for plunging into water. Long, narrow and streamlined, it steadily increases in diameter from the tipto the head. This reduces the impact when the bird hits the water. The bird slides in, the water flowing part the beak rather than being pushed in front of it.

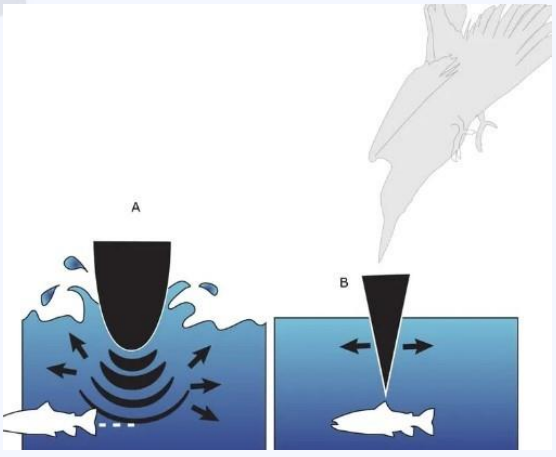

Figure 3 Aerodynamics of Beak

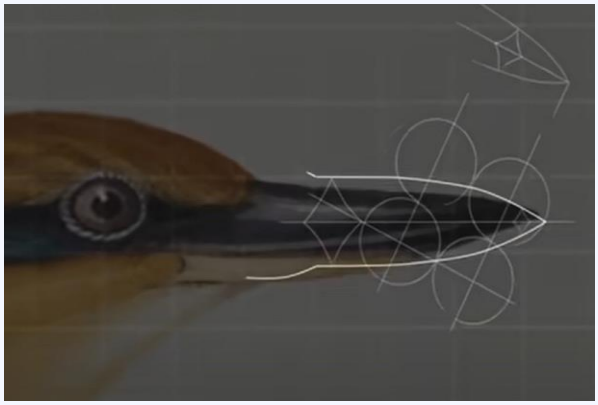

Figure 4 Beak

Exactly what the bullet train was failing to do. The train team studided the beak, the beak resembled two triangles with round edged together forming a squashed diamond shape and so a kingfisher's bill helped them design the train nose.

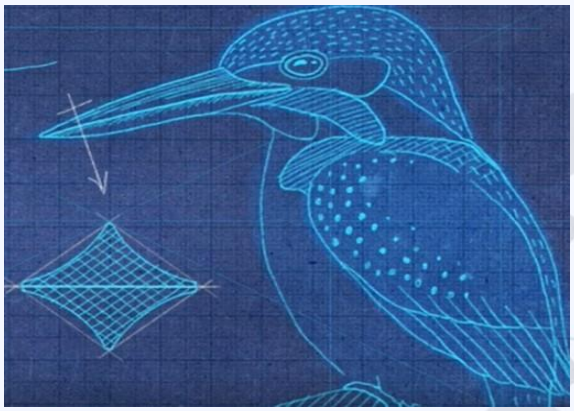

Figure 5 Squashed Diamond Shape

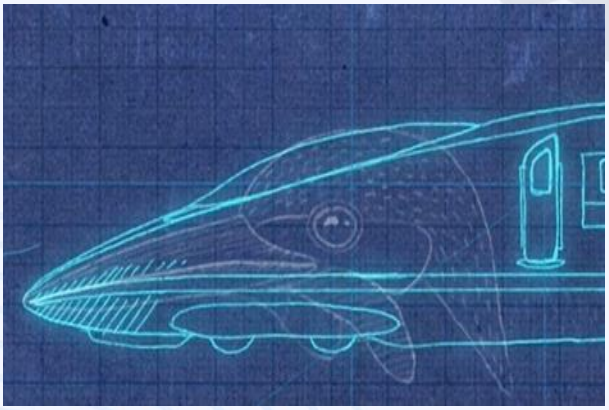

Figure 6 Shinkansen Bullet train

When it was tested, the kingfisher bullet train was faster, quieter, more powerful, consumed 15% less electricity, and with 30% less air resistance than before.

V REFERENCES

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Bio-Inspired Solutions for Space Challenges: A Focus on Indian Space Exploration

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Abstract – This research paper delves into the significance of biomimetics in the field of space exploration and explores the vital role of biomimetics in the context of Indian space exploration. Biomimetics, the emulation of biological systems and processes, has increasingly played a pivotal role in addressing challenges faced by space exploration missions. As the Indian Space Research Organisation (ISRO) continues to advance its space missions, biomimetics has emerged as a critical tool for overcoming the unique challenges posed by space exploration. This paper provides an overview of the historical evolution, recent developments, the imperative need, and future potential of biomimetics in ISRO's space programs, highlighting the innovative and sustainable solutions it offers. By drawing inspiration from nature, scientists and engineers can advance space exploration technologies, making missions more efficient, sustainable, and successful.

Keywords: Biomimetics, Indian Space Exploration, Bio-inspired Design, Aerospace Engineering, Biomimicry, Exobiology, Nature-inspired approach, Revolutionize, Turning to nature.

I. INTRODUCTION

Space exploration has been a focal point of scientific and technological advancement for decades. To meet the growing demands of space exploration, scientists and engineers are constantly seeking innovative solutions. Biomimetics, also known as biomimicry or bio-inspired design, involves the imitation of biological systems, structures, and processes to develop technological solutions. This approach has gained so prominence in space exploration, enabling the development of spacecraft and instruments that are better suited to the harsh conditions of space and extraterrestrial environments. Indian space exploration, spearheaded by the Indian Space Research Organisation (ISRO), has made remarkable progress in recent decades. With ambitious missions to the Moon, Mars, and beyond, the need for innovative solutions to enhance mission efficiency and success has become increasingly evident.

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II HISTORICAL EVOLUTION

Indian space exploration is a fascinating journey that reflects the nation's innovative approach to tackling the unique challenges of space exploration. Below is a brief overview of the history of biomimetics in Indian space exploration:

1. **Early Missions and Inspirations (1960s-1980s):**
   The Indian Space Research Organisation (ISRO) was founded in 1969, and during its early years, the organization focused on establishing the fundamental infrastructure for space research and satellite technology. Biomimetics was not a prominent feature at this stage, as the primary focus was on building launch vehicles and communication satellites.
2. **Emergence of Biomimetics (1990s-2000s):**
   As ISRO gained more experience in space missions, the organization began to explore biomimetic principles for spacecraft design and instrumentation. This period saw the integration of bio-inspired solutions into various aspects of space exploration, including spacecraft design, materials, and robotics.

A. ***Lightweight Materials:*** ISRO researchers drew inspiration from nature to develop lightweight and strong materials for satellite construction, similar to the way bones and shells are structured. This helped reduce the weight of satellites and launch costs.

B. ***Adhesion and Locomotion:*** ISRO researchers explored gecko-inspired adhesives for gripping and moving on surfaces in microgravity environments.

1. **Chandrayaan and Mars Orbiter Mission (Mangalyaan):**
   ISRO's Chandrayaan-1 mission (2008) and Mars Orbiter Mission (Mangalyaan, 2013) marked significant milestones in India's space exploration efforts. While not exclusively biomimetic, these missions incorporated innovative engineering and instrumentation that drew inspiration from biological systems to enhance their functionality and efficiency.

III THE IMPERATIVE NEED

The need for biomimetics in Indian space exploration programs arises from the unique challenges posed by space missions and the potential benefits that nature-inspired solutions can offer. Here's a list of the need for biomimetics in Indian space exploration programs:

A. Extreme Environments:
Biomimetics offers the opportunity to draw inspiration from organisms that have adapted to extreme environments on Earth, such as extremophiles, to design systems that can withstand space's rigors.

B. Efficiency and Sustainability:
Biomimetic designs often prioritize efficiency and sustainability. In space exploration, resources are limited, and efficiency is crucial for conserving energy, water, and other supplies.

C. Adaptability:
The dynamic and unpredictable nature of space missions necessitates adaptability. Biomimetics allows for the development of spacecraft and equipment that can respond to changing conditions and unforeseen challenges.

D. Bio-Inspired Materials:
Indian space exploration programs can benefit from biomimetic materials that mimic the strength and resilience of natural structures, such as bones and spider silk.

E. Enhanced Sensing and Communication:
Biomimetic sensors can improve the detection and communication capabilities of spacecraft. By emulating the sensory organs of animals or the communication strategies of insects.

F. Robotic Systems and Mobility:
Biomimetics systems can mimic the locomotion and manipulation capabilities of living organisms, enabling them to navigate challenging terrains, collect samples, and perform intricate tasks with precision.

G. Life Support Systems:
Biomimetic approaches can enhance life support systems by emulating biological processes that convert waste into valuable resources, such as water and oxygen.

IV ONGOING RESEARCH & FUTURE PROSPECTS

ISRO continues to invest in biomimetic research for space exploration. The organization is exploring bio-inspired solutions for propulsion systems, advanced sensors, and habitat design for potential future missions to the Moon and beyond. The study of extremophiles and exobiology is also informing the development of life-detection instruments for astrobiology missions. The incorporation of bio-inspired solutions in spacecraft design, materials, and instrumentation reflects ISRO's commitment to innovation and adaptability in the pursuit of space exploration goals. The future holds promise for further advancements in biomimetics within Indian space exploration endeavours.

V CONCLUSION

In conclusion, while India's space exploration program has a relatively short history compared to some other nations, it has progressively embraced biomimetics to enhance the efficiency and effectiveness of its missions. The need for biomimetics in Indian space exploration programs is driven by the desire to overcome the unique challenges of space missions, improve efficiency, and ensure the sustainability of space exploration initiatives. By drawing inspiration from nature, Indian space exploration programs can develop innovative and adaptive technologies that contribute to the success of missions and the advancement of space exploration capabilities.

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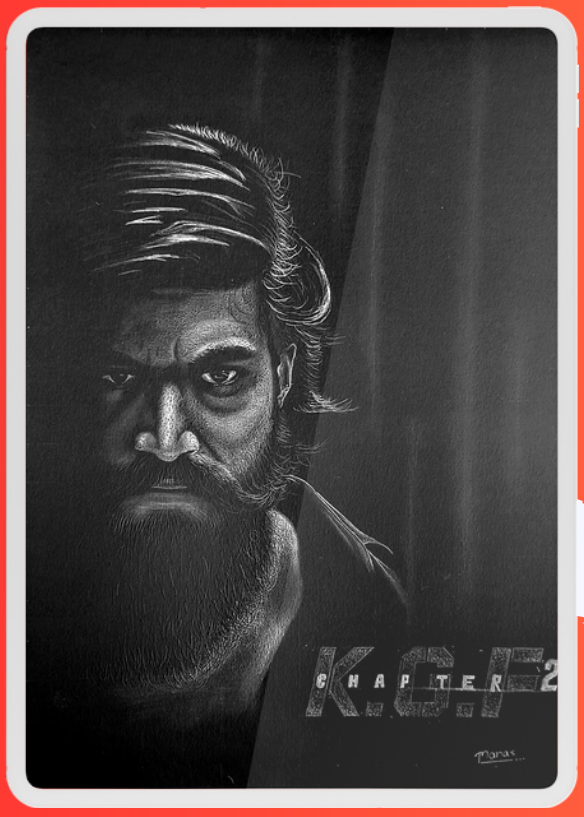
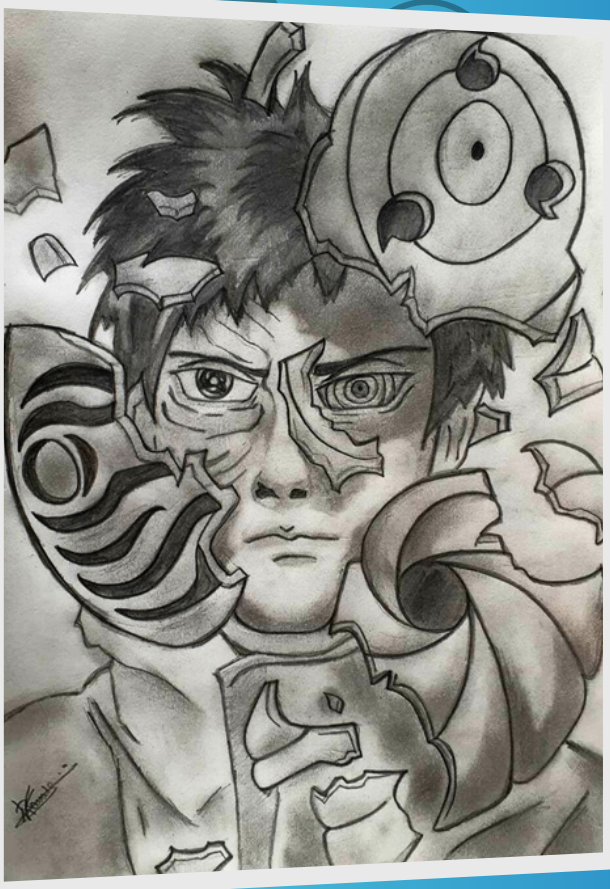
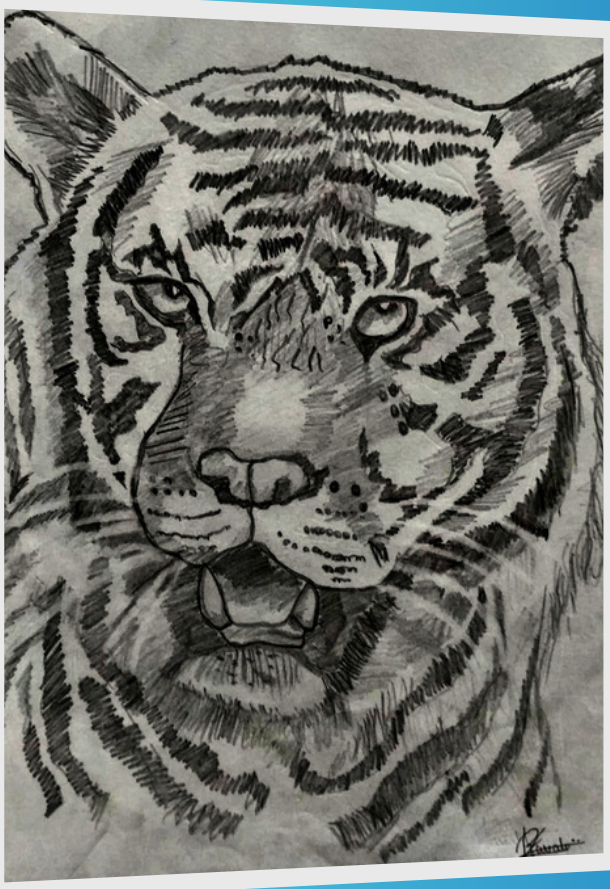
Creative Corner

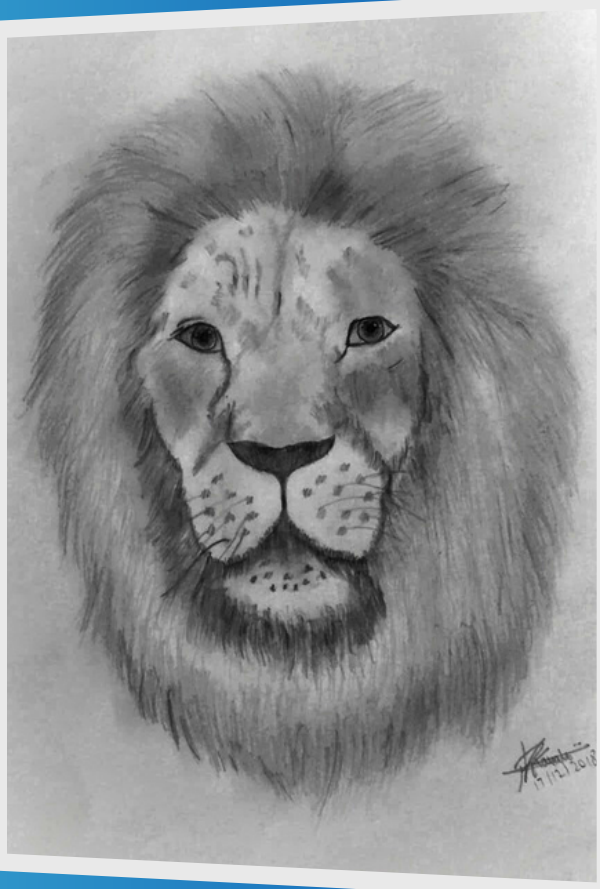


Manas Mali

Mech 3 A



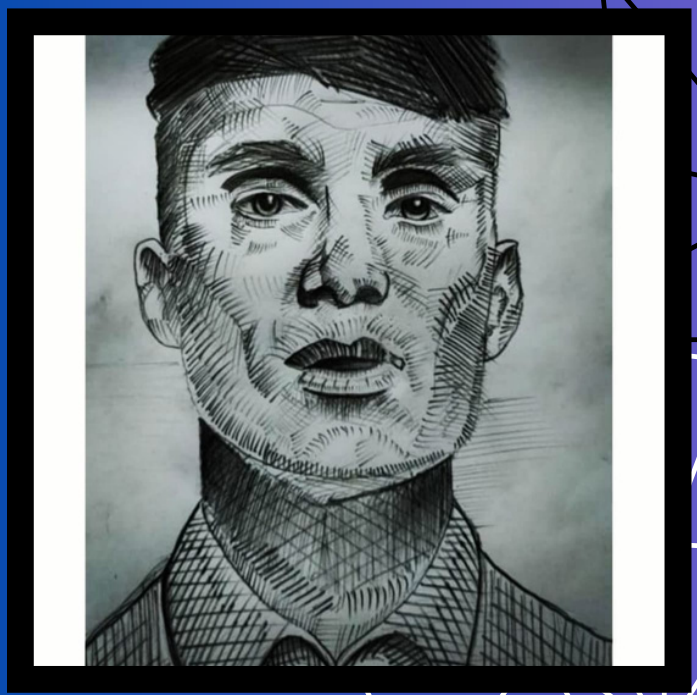


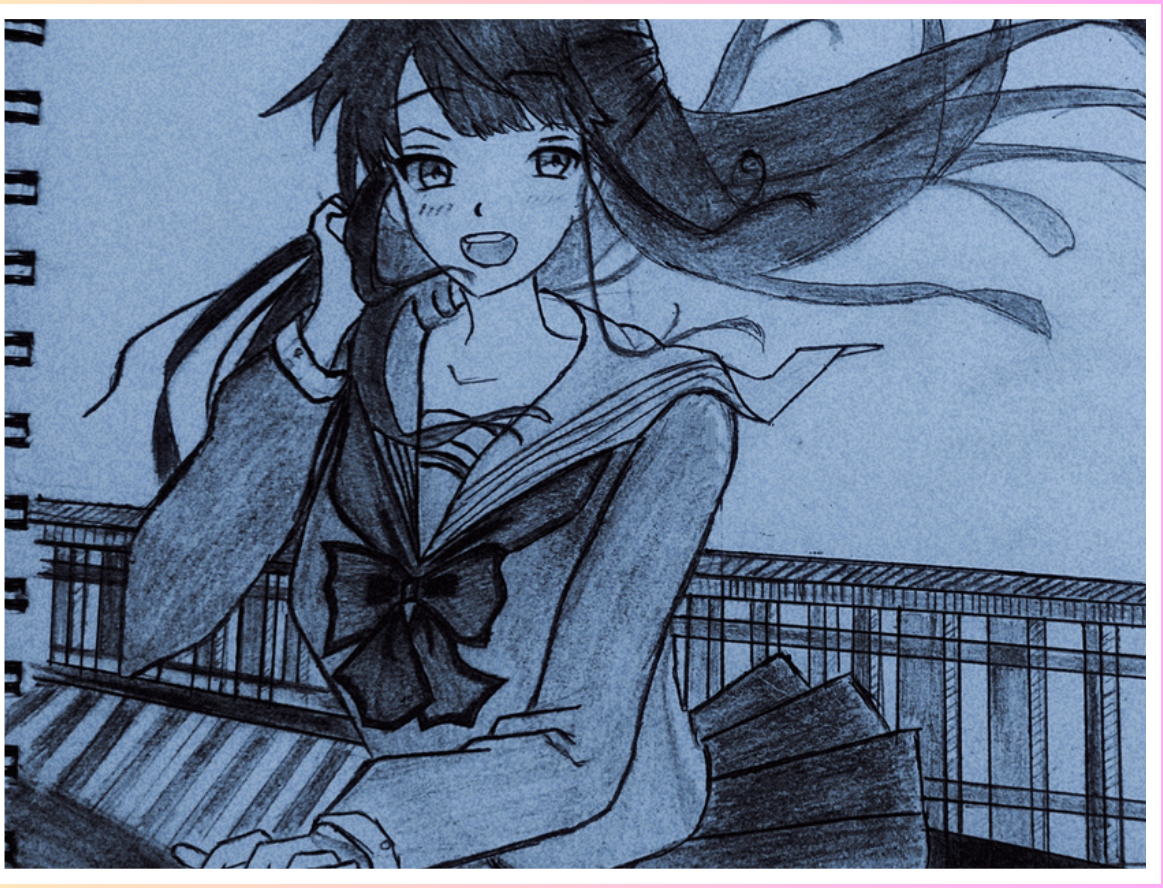


Rugved Kavale

Mech 5 A

Veeresh Hanji
Mech 5 A



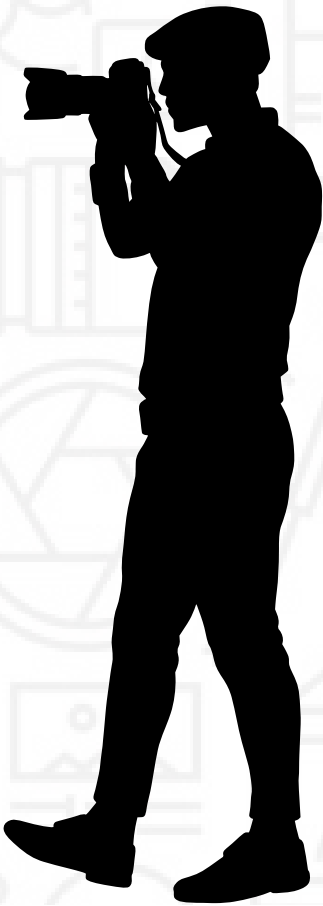


Ananya Sastry - Mech 5 B

Khushi Sharma

Mech 5 B

Photography



Anuj Kabra

Mech 5 A

Vardhan Dhoble

Mech 3 A

Rugved Kavale

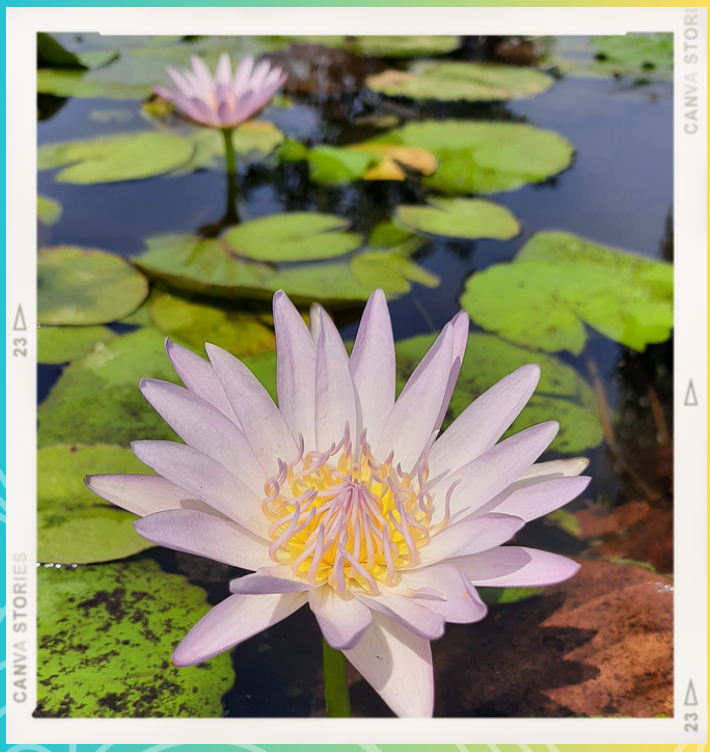
Mech 5 A

Shubham Bankar

Mech 5 A

Amey Yewale

Mech 5 B



Mahika Aigalikar

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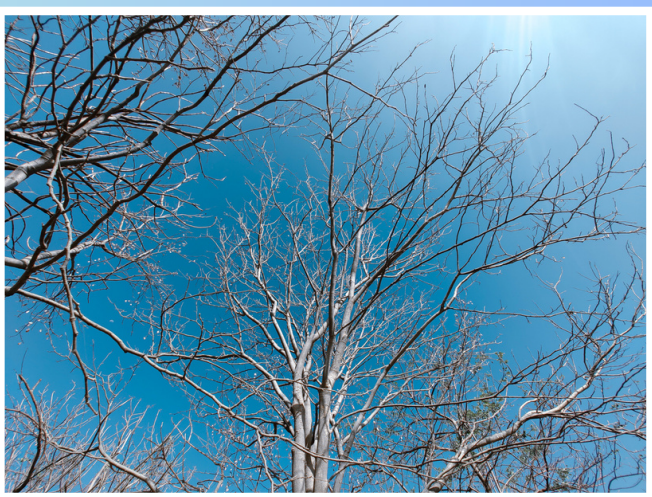
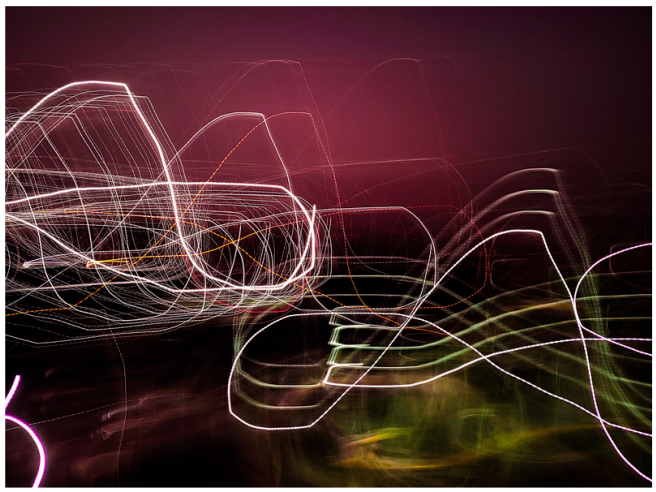
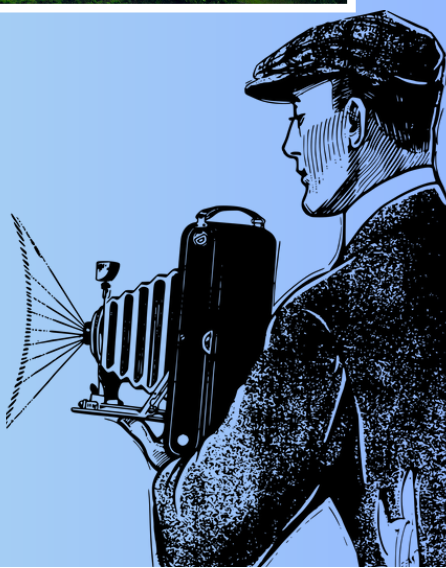
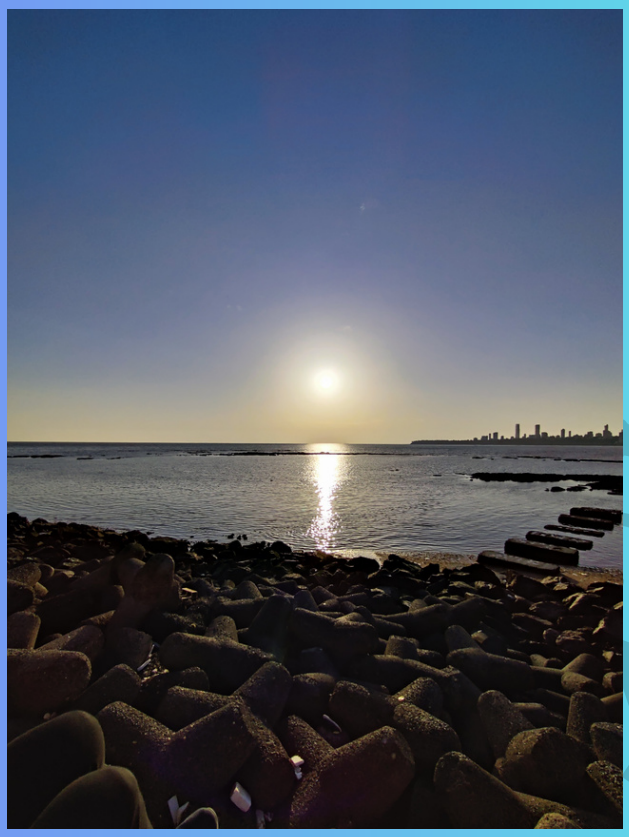






Athul Krishna.T.B

Mech 5 A



Aditya Jadhav

Mech 5 A

Poems

SECRETLY, DON'T YOU?

"Afterall,
You do have a sweetheart back
home. Don't you?
A moment, to cherish:
Of a promise, Of a song,
Of a movie screen, Of a prom,
Crawls up slowly to your heart,
From the heavy fingertips
It starts;
Her tantrums, Spasm on the face,
A wide gummy grin, At the gate.
Eyes, Those tell, Sweet little lies,
Sweet little secrets.
In a noisy moment amidst chaos:
Of a life changing shower,
Of a life changing shower,
Of a rashly driven cr,
Of a breathtaking sprint, To work,
Of everlasting failure. Of misery,
Of thoughts, Of pain.
You keep her close, You smile with her,
Laugh, Giggle,
Even from that far.
Secretly, Don't you?"

-Mrunmayee Paunikar (Mech 7A)

अपनेकांधेपर सर रखनेकी जगह, उधार दोगे क्या तुम?

अगर ककसी कदन,
मन ना लगेमेरा कही,
तुम बस मेरा हाथ थाम कर
मुझे अपनेसाथ छत पर लेजाना.

तुम एक लफ़्ज़ भी ना कहना मुझसे
बस मेरे पास बैठ कर
मेरी तनहाा्य को अपनी परछाई का
साया दे देना.

तुम्हारे सिर्फ करीब होने के एहसास से,
सब कुछ ठीक हो जाता है।
तोह अगर हो सकेतोह,
मेरेसर को अपनेकंधेपर

थोड़ी सी...सिर्फ थोड़ी सी... जगह उधार देदनो.

-Pradeep Kumawat (Mech 5B)

RAIN'S EMBRACE

In the hush of twilight's embrace,
Comes a gift from the heavens, a gentle grace.
A symphony of nature, a soothing refrain,
The world comes alive, refreshed by the rain.

Drops descend from the sky so high,
Like silver threads from a tapestry in the sky.
They kiss the earth with a delicate touch,
Awakening life, they mean so much.

On rooftops, they dance in a joyous parade,
A liquid ballet in the moonlight's shade.
They cleanse the air, washing troubles away,
In the tranquil rhythm of a watery ballet.

Children giggle as they splash and play,
In puddles formed by the rain's display.
The world is transformed, a canvas reborn,
In the gentle embrace of a raindrop's morn.

So let the rain fall, let it cleanse the soul,
In its tears of joy, we find our role.
To cherish the moments it brings our way,
In the beauty of rain, we'll forever sway.

-Anonymous

तुझसे दूर होकर भी मैं तेरा दीदार कर आता हूँ

आज भी गुज़रता हूं मैं उन गलियों से,
जिन गलियों में हम साथ घुमा करते थे।

अब मेरी नज़र नहीं तलाशती तुम्हें उन गलियों में,
बस महसूस करता हूं मैं वो लम्हे वहां के
जब हम साथ-साथ उन गलियों में घूमते थे।

अब मेरी नज़र तुम्हारे चेहरे को देखने की ज़रूरत नहीं है,
बस तुम्हारे पास होने का एक एहसास सा मुझे
उन गलियों में होता है।

दूर से ही तेरे बालों की वो खुशबू मेरे पास अजाती है
और बस इसी के सहारे हम तुझे ना देख कर भी
तेरा दीदार कर आता है।

-Pradeep Kumawat (Mech 5B)

STUDENTS ACHIEVEMENTS

Sr. No.	Name	Name of the events/competition/ workshop etc	Organizing Institute/Body and its location
1	Mhatre Vinit	Techathlon	Etamax, FCRIT
2	Shreyash Parab	3rd Rank In Mechanical Engineering 2nd Year	Mechanical Dept, FCRIT
3	Soham Nevgi	Rocket X 2.0	Calibre, MESA FCRIT
4	Mayur Shamrao Patil	Ideathon	Institute of Engineers (IEI), Navi Mumbai Local Centre
5	Saurabh Patil	Algorithm 7.0 Hackathon	Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai
6	Dhananjay Mahadev Pawar	Ideathon	Institute of Engineers (IEI), Navi Mumbai Local Centre
7	Om Vivekanand Sawant	Ideathon	Institute of Engineers (IEI), Navi Mumbai Local Centre
8	Safhan Eliyas Shirgaonkar	Algorithm 7.0 Hackathon	Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai
9	Arjun Patil	Caddict	Calibre, MESA FCRIT
10	Omkar Patil	Quiz Competition	ISHRAE, Mumbai Chapter

STUDENTS ACHIEVEMENTS

11	Rupesh Choudhari	Quiz Competition	ISHRAE, Mumbai Chapter
12	Shreya Patil	Rangoli-Marathi Raj Bhasha Din	Marathi Mandal, FCRIT
13	Atharva Bapat	Mock Interview (Jamboree-Ishrae)	ISHRAE, Mumbai Chapter
14	Cardoza Francisca Stanny	Master Chef	Etamax, FCRIT
15	Kewat Chirag Prahlad	National Level Poster Presentation Competition	Calibre, MESA FCRIT
17	Princeton Dsilva	Masterchef FCRIT, Ideathon, Poster Presentation (ICNTE-2023)	Etamax, Calibre-MESA, ICNTE, FCRIT
18	Mohite Abhishek Manik	Tech Relay	Etamax, FCRIT
19	Patkar Suyash Sanjay	Art Attack (Sketching Competition)	Etamax, FCRIT
20	Aditi Shinde	5th Biennial International Conference on Nascent Technologies in Engineering	ICNTE, FCRIT
21	Yash Vaidya	Poster Presentation - ICNTE -2023	ICNTE, FCRIT
22	Yash Chaudhary	Quido	MESA, FCRIT

FACULTY ACHIEVEMENTS

Sr. No.	Name of the Faculty	Particulars	Year
1	Dr. Nilaj Deshmukh	Keynote Speaker, 2nd Global of Summit and Expo on Aerospace and Mechanical Engineering (GSEAME-2022)	2022-23
2	Dr. Nilaj Deshmukh	Member of the Judge Panel, IEI-FCRIT Excellenece Awards 2022	2022-23
3	Dr. Nilaj Deshmukh	Scrunity committee Member, IEI-FCRIT Excellenece Awards 2022	2022-23
4	Dr. Nilaj Deshmukh	Jury Member, Maharashtra Startup Yatra 2022, Maharashtra State Innovation Society	2022-23
5	Dr. Nilaj Deshmukh	Chair of IEI-FCRIT Excellenece Awards 2022	2022-23
6	Dr. Nilaj Deshmukh	Keynote Speaker, 3rd International conference on Emerging Trends in Engineering and Technology, Nashik	2022-23
7	Dr. Aqleem Siddiqui	Conference Chair, CVS, INVEST 2022	2022-23

FACULTY ACHIEVEMENTS

8	Mr. Badal Kudachi	Published Book - Engineering Thermodynamics", ISBN: 978-93-5451-560-6, July 2022, Nirali Prakashan Publisher	2022-23
9	Dr. Nilaj Deshmukh & Mr Praseed Kumar	Best Paper Award for Paper titled "Design and Development of Semi-Automated Multipurpose Electric Farming Bot" in 5th Biennial ICNTE, Vashi	2022-23
10	Ms. Shamim P	Expert lecture, AVNL Institute of learning, Ambernath	2022-23

PLACEMENT DATA

SR. NO.	NAME OF THE STUDENT	NAME OF THE EMPLOYER
1	Rupanjon Dasgupta	TCS
2	Nageshwar Manik Avhad	TCS
3	Aniket Ankush Bagate	TCS
4	Saif Siraj Deshmukh	TCS
5	Krishnan A.Balasubrahmanian	TCS
6	Achare Yash Sanjay	TCS
7	Sannial Dsouza	TCS
8	Abhishek Manik Mohite	TCS
		Afcons
9	Suyash Sanjay Patkar	TCS
		Afcons
10	Marmika Saxena	TCS
11	Shubham Prashant Thorat	TCS
12	Shivam Parab	TCS
		Mukand Ltd
13	Pratik Patil	TCS
		Avishakti Rooftop Solar
14	Adnan Ahmed Saleem Ahmed	TCS
		Mukand Ltd
15	Apurva More	TCS
		Godrej & Boyce
16	Harsh Chaudhary	Technip India Ltd
17	Ritu Khimasiya	Technip India Ltd
18	Srushti Shardul	Technip India Ltd
19	Sanchart Raina	Accenture
20	Shubham Maruti Suryawanshi	Accenture
		Cognizant (GenC)
21	Chinmay Desai	Cognizant (GenC)
		Afcons
		LTI

PLACEMENT DATA

22	Sayyed Mohammed Qasim Saiful	Cognizant (GenC)
		Mukand Ltd
23	Pratik Reddy	Techint India Pvt. Ltd.
24	Rushikesh Dnyaneshwar Suryawanshi	Techint India Pvt. Ltd.
25	Shreyansh Gupta	L & T
26	Pawan Rajendra Gole	L & T
		TCS
27	Shreya Milind Dhopeskar	Faurecia
		L & T
28	Joyna Suryawanshi	Faurecia
29	Merwyne Crasto	SHM Group
30	Venkata Sai Akash Navuduri	Yokohama
31	Rutwik Saste	Yokohama
		Godrej & Boyce
32	Jason Veigas	Yokohama /
33	Baskey Rupay Laxman	Mukand Ltd
34	Kushal Chavan	Godrej & Boyce
35	Chetan Ashok Aade	Godrej & Boyce
36	Aditya Santosh Gawde	Godrej & Boyce
37	Pranav. V. Ghanvat	Primetals
38	Akshaykumar Subhash Kodag	Everest Industries
39	Ritesh Ramdas Langhe	Primetals
		Tecnimont
40	Parth Lokhande	Godrej & Boyce
41	Mayur Ashok Madame	Mukand Ltd
42	Shubham Malkar	Godrej & Boyce
43	Joshua Francis Jerome Mendonce	Godrej & Boyce
44	Yash Metkari	Cybermarine
		SHM Group
45	Ziyad Mujahid Mulla	Everest Industries
46	Aaron Rodricks	Mukand Ltd
47	Shriyans Murari	Godrej & Boyce

PLACEMENT DATA

48	Akash Singh	Godrej & Boyce
49	Ammar Khan	Mukand Ltd
50	Christo Sibi Pulimootil	Sarman Engineering /
51	Roshan Thomas Jacob	Mukand Ltd
52	Noel Varghese	Tecnimont
53	Sarathi Padhy	Tecnimont
54	Atharva Parulekar	Mukand Ltd
55	Kapil Mahadev Patil	Godrej & Boyce
56	Tejas Subodh Patil	Cybermarine
57	Siddharth Porji	Afcons
58	Omkar Datta Shinde	Mukand Ltd
59	Swanand D Shembekar	Godrej & Boyce
60	Natesh Shetty	Tecnimont
61	Sumil Sunny	SHM Group
62	Indrakumar Tak	Primetals
63	Savio Vincent Thaikadan	UTPNN
64	Krishnan Nilakantan	Sarman Engineering
		Sparrows Group
65	Darrel Rebeiro	Godrej & Boyce
66	Sahil Kotian	SHM Group
		Sparrows Group
67	Chirag Kewat	RK Foodland
68	Nimesh Vijay Rokade	RK Foodland
69	Stephen Nadar	RK Foodland
70	Shreyas Sunil Pawar	Afcons
71	Harsh Tripathi	Afcons
72	Pratiksha Vijay Pawar	Ball Corporation
73	Rajam Jayesh Shrikrishna	L & T
74	Vaz Jorson Suresh Poojary	Corrosion Technology Services/

LIST OF TOPPERS

TOPPER LIST – SEM VIII (SGPI)

NAME OF STUDENTS	SGPI
J OM PRASAD	10
BAG VAIDEHI	10
REBEIRO DARREL	10
DESAI CHINMAY	9.85
PORJI SIDDARTH	9.85
PATIL SHREYANSH	9.85
SHARDUL SRUSHTI	9.7
KHIMASIYA RITU	9.7

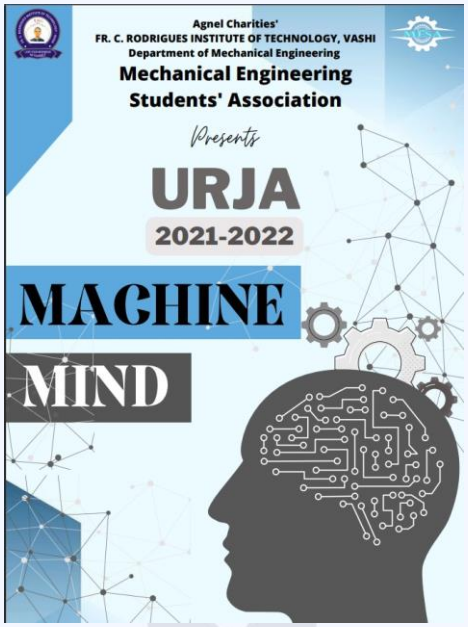
TOPPER LIST – SEM VI (CGPI)

NAME OF STUDENTS	CGPI
MAYUR DATTARAM	9.91
JAGRAJ SINGH	9.86
KOLI PRANAV	9.75

TOPPER LIST – SEM IV (CGPI)

NAME OF STUDENTS	CGPI
DINKAR SUMEDH	9.64
SHINGARE SIDDHIK	9.17
VERNEKAR DHRUV	9

SYNERGY 2022



SYNERGY is organized with the aim of bridging the gap between the industry and the institute and facilitates an effective interaction between them. This event provides an opportunity for the students as well as the faculty members to know more about the emerging technologies and methodologies adopted by the industry. Also, the industry in turn, gets to know the institute closely, thereby providing an opportunity to identify the value addition required to create high class professionals from the institute. Synergy 2022 was the latest edition of our vibrant and vigorous industry-academia interaction.

It was held on 20 th August 2022 at the premises of our very own college Fr. C. Rodrigues Institute of Technology, Vashi. We were fortunate to have guest speakers from Godrej and Boyce Mfg (Vikhroli, Mumbai) to interact with students. Mr. Sagar Garje (Designation: Assistant Manager) and Mr. Sagar Kakani (Designation: Associate Manager) were the keynote speakers who graced us with their presence and shared their valuable knowledge and experience with students. The speaker dealt with technical aspects of and opportunities in their field. It was followed by an open interaction where there was wholehearted involvement from the students.

PRESIDENT'S NOTE 2022-23

I vividly recollect each and every instance spanning from my initial day to the present moment. It feels as though it was just recently that I embarked on my first day at this location. The passage of time seemed leisurely, forming a distinctive and meaningful attachment to this place. Notably, the cornerstone of our progress was cultivating mutual trust as we collaboratively functioned as a team. Operating under the guidance of the senior council, we achieved all commendable milestones. Our strategy initiation involved a partnership with faculty members and synchronization with the Head of Department. While conceiving fresh event concepts, we remained attuned to the insights and lessons derived from past experiences. Thanks to the committed endeavours of our team, we managed to amass substantial resources that facilitated the realization of our plans. Our diligence and dedication led to an expansion of the fest into a triumphant three-day spectacle. With multiple activities seamlessly progressing, the event unfolded as envisioned. The day of CALIBRE 2k22's commencement arrived, greeted by resounding enthusiasm and constructive feedback for all scheduled events. Culminating the event left us all joyously elated. Participating in MESA for an entire year was a profoundly enriching experience. Collaboratively, we organized and executed Synergy 2022, which significantly bolstered coordination and mutual understanding amongst team members. Now, after expending considerable effort, the time has come to bid farewell. Concluding, I extend my profound gratitude to all colleagues, senior members, faculty coordinators, and the well-wishers of MESA for their unceasing support and belief in us.

- Leon Benjamin,
President Mesa 2022-23

PRESIDENT'S NOTE 2023-24

I still remember each and every moment from the first day to the present day. It seems like yesterday was the day when I had my first day at this place. Working under the senior council's direction, we successfully completed Synergy 2022 and Mesh 2023. With their guidance and understanding, we marched forward with confidence and determination for the upcoming challenges. We started planning with the help of our faculty members, while also coordinating with the HOD. With all activities running concurrently, everything went as planned, and when the event date arrived, we were all extremely excited. The first day of CALIBRE 2k23 began, and all of the scheduled events received overwhelming support and positive feedback. Being a part of MESA for a complete year was one of the best experiences we could have had. New members joined our team, became a part of the Mesa family, and together we planned and conducted Synergy 2023, which helped the team members improve their coordination and understanding, bridged the gap between our ideas and perspectives, and refined our skills. After so much hard work, now is time to say goodbye but at the end, we must keep moving forward taking the responsibility. Thank you for making this journey possible for us and helping us in every way possible. On everyone's behalf, I would, like to conclude by wishing all of you the best for your future endeavors. Finally, I'd like to express my gratitude to all of my colleagues and my senior members for their constant support, as well as the faculty coordinators for their belief in me and my team and all of MESA's well-wishers.

- Dhananjay Khairnar
President Mesa 2023-24

ISHRAE COLLEGIATE CHAPTER

The Indian Society of Heating Refrigeration and Air Conditioning Engineers (ISHRAE) was founded to promote the HVAC industry in India. The student chapter aims to provide the student members with industry exposure and get them more involved in HVAC. The ISHRAE student chapter of FCRIT was started with the goal of getting new opportunities for students in the field of HVAC specifically and providing a stable career in the same. The FCRIT chapter was initiated on 22nd September 2007. Mr Nilesh Varkute and Ms Neha Pandit are the faculty advisors of the FCRIT chapter. ISHRAE organizes various events like Exhibitions, Quizzes, Technical Paper Presentations, Industrial visits, Job Junctions, etc.

The installation of the Students Chapter, FCRIT, 2022 – 2023, was conducted in College Seminar Hall of Mech. This event was attended by the appointed council of the FCRIT Chapter (President, Secretary, Treasurer and Committee Members) along with the Faculty Advisor and other ISHRAE Student Members. The chief members of the Mumbai Chapter Mr Nasir Khan, Dr. Kavita Dhanawade, Mr Amod Dikshit, Mr Sanjay Jadhav and Mr Vivek Marde gave some encouraging words. This was followed by the installation of the President, Secretary and Treasurer of each Student Chapter by Dr Kavita Dhanawade. After that, the present Student President Ms Mrunmayee Paunikar shared her experience in ISHRAE and gave a brief about the future activities to be held at FCRIT under her leadership. Mr. Prathamesh Shedge, the Secretary, gave a vote of thanks to all the chief guests.

1) ISHRAE organized two visits to Auro Engineering in Andheri West, where students gained insights into Air Management systems, including AHU (Double Skin/Single Skin), FCU, Air Washers (Single/Double Stage), Air Scrubbers (Wet/Dry-type with ESP Technology), Rectangular Factory Fabricated Ducts (GI/AL/SS), and Pre-Insulated Ducting (PIR Panel Duct).

2) ISHRAE's K-12 committee is dedicated to promoting STEM education among K-12 students. The ISHRAE FCRIT Chapter organized four K12 activities, including Yoga, Education, Sports, and Motivational sessions. The Motivational Talk aimed to inspire Ambele Village students about the importance of basic education. The Educational Session focused on raising awareness about climate change and its environmental impacts, covering topics like global warming, plastic waste, pollution, and possible solutions. Students also learned about alternative energy sources such as solar, wind, nuclear, and tidal energy. The session emphasized proper plastic waste disposal and pollution reduction to mitigate the harmful effects of climatic changes on the environment.

3) At ACREX EXPO, South Asia's largest HVAC exhibition, 26 volunteers from FCRIT Mumbai Chapter managed the cafeteria for three days. The expo focused on technological advancements in the HVAC sector for a better future. ACREX INDIA 2023 featured exhibitors and visitors from over 40 countries. A seminar on 'Engineering Towards Net Zero' was organized by Acrex India and Blue Star, where four student members from ISHRAE FCRIT Chapter shared their HVAC knowledge and thoughts on achieving net-zero engineering.

4) Indoor Air Quality Program: FCRIT students actively engaged in ISHRAE Mumbai Chapter's Indoor Air Quality program.

5) Two ISHRAE FCRIT CHAPTER students, Pranit Janardhan Tamboli and Upendra Udayabhan Yadav, secured the second prize in an e-poster online competition on Alternative Refrigerants Evaluation for Room Air Conditioners.

6) Students Baniz Antony and Mrunmayee Paunikar secured third place in the AQUEST zonal level quiz competition.

7) 26 FCRIT Mumbai Chapter members participated in a Jamboree event Saraswati College, with Atharva Bhapat winning first place in the Mock Interview category of and a team of four students placing second in the Quiz Competition.

8) Mrs. Ekta Mishra, assisted by faculty guides Prof. Nilesh Varkute and Prof. Neha Pandit, conducted a webinar which was attended by 58 students. The session discussed the integration of solar PV panels for buildings and the grid, providing insights into various industrial applications and future trends in solar PV projects supported by ISHRAE.

SAE COLLEGIATE CHAPTER

SAEINDIA is an affiliate society of SAE International registered in India as an Indian non-profit engineering and scientific society dedicated to the advancement of mobility industry in India. The founding principle of SAE International is to unite scientific and technical staff to perform free academic discussions, dedicate themselves to the cause of prospering the science and technology for automotive vehicles and to make contributions to speed up the modernization of the automotive industry.

The Club actively organizes various events such as TORQUE - Intercollege event of Nitro Racing and IGNITION- Seminar by speakers from the automobile sector. Prof. Kamlesh Sasane and Dr. Aqleem Siddiqui are the faculty advisors for SAEINDIA COLLEGIATE CHAPTER. The Mechanical Department has an SAE Collegiate Club, having more than 50 members.

SAE India FCRIT is a collegiate club dedicated to providing students with automotive knowledge. They host various technical events, with "TORQUE" being their flagship event held on March 16, 2023. TORQUE is an intercollegiate nitro radio-controlled car racing competition at Fr. C. R. Institute of Technology, drawing participants from across Mumbai. Teams navigate a challenging dirt track with IC Engine powered RC Cars, showcasing their determination. TORQUE 23 featured diverse track events, supported by dedicated staff, council members, and volunteers. It attracted a large audience, including students and faculty, and the four participating teams presented impressive displays of their RC cars, offering valuable driving insights. The winning team received cash prizes from distinguished guests, including Fr. Sebi, Dr. SM Khot, and Dr. Nilaj Deshmukh, along with faculty members from the mechanical department.

SAE INDIA FCRIT organizes webinars and seminars, including the annual 'Ignition X' expert lecture series. The latest event, held on August 31, 2023, featured Mr. Zill Savla, an automotive expert with extensive technical and marketing experience. He provided insights into the engineering journey and discussed luxury and sports cars, offering a comprehensive overview of the evolving automotive industry. The seminar brought together industry experts, enthusiasts, and professionals, facilitating discussions on various aspects of this dynamic sector. Attendees gained a deeper understanding of design, technology, market trends, and future prospects in the luxury and sports car segments. The event concluded with a Q&A session and a vote of thanks from the SAE council.

BAJA SAE INDIA

Our SAEINDIA collegiate team “Team Kaiser Racing” consists of 30 automobile enthusiasts who take part in events that include the design and fabrication of an ATV as well as the actual event which includes an endurance race. The team is led by Captain Prathamesh Mane and Vice-captain Hardik Thasale and guided by faculty advisors Dr. Dhananjay Panchagade and Mr. Sandeep Arote. The competition is a measure of how well a vehicle is designed, modeled, and constructed in all respects. The overall participation and innovation by students are proof that mechanically and aerodynamically sound buggies are just the beginning of FCRIT’s contribution to the automobile sector.

The team made a stunning debut two years ago, the team made sure the alterations concerning design improvement were implemented and the car stood tall and roared well before the event. This marked the beginning of, what would prove to be, a very successful journey.

The journey from the inauguration to the event is never a cakewalk, the team faced challenges befalling it with sleepless nights and tiring days. The path was narrow and curvy but the team drifted through each turn with a firm mindset.

In 2018-19, TKR was Ranked 129th of 295 teams, ranked 14th in the final endurance test, ranked1st among new teams in the final race, and ranked 13th in the Design Evaluation report. In 2019- 20, TKR was one of only 32 teams to finish the endurance test, ranked 43rd all over India in virtual rounds and 15th in the Design Evaluation report. In the 2020-21 edition of BAJA, TKR ranked 55th all over India in the Sales event of the virtual rounds. Unfortunately, due to the COVID-19 pandemic, it was not possible to conduct BAJA. The team successfully completed the BAJA 2023 event with overall ranking of AIR 28 among 104 teams and 17th in the Endurance Race among 42 teams.

The comeback of the team from the pandemic wasn’t going to be easy, but with the motivation and hunger that fills the team's mindset, the team definitely was a shining star throughout this season!

The team also participated in ATVC 2023. The event was held at Nutan Maharashtra PCOET College Of Engineering, Talegaon, Pune, Maharashtra. Here the team bagged-

Overall rank of AIR 8th of 80 teams

Endurance Rank – 9th of 21 teams

Design Evaluation – 8th of 80 teams

Business and Cost Evaluation – 3rd of 80 teams

This was a different Endurance where the Electric and the Combustion vehicles were running parallel. It was a neck-to-neck competition including hard core racing. Where the pit crew did a commendable job of performing major repairs on the vehicle in nick of time. The competition proved to be the real deal by putting the entire team through challenges that were never faced before. The Team completed the 3 hours long Endurance race completely. The end of the day was marked with the Valedictory function and we are proud to say that the Mr. Harsh Chaudhary won the award of Best Vice-Captain.

AERO FCRIT

A team of 7 members aspiring to fly high, set a spark for the foundation of Aero Club in 2019. The team registered for their first event SAE Aero Design Challenge in August 2019 and started with the journey of Aero Design i.e., the designing and fabrication of a highly stable heavy lifting RC aircraft falling under given constraints.

All the efforts put in by every member of the team paid off, as they secured an impressive 5th place in the technical presentation round and 16th for the report submitted in the year 2020 and secured third place in the technical report submission round in the year 2021.

For this year 2022-23 we the members of AeroFCRIT are fully prepared for the SAE Aero design Challenge, as we have designed and fabricated the fixed wing UAV throughout the course of this year and will be competing for the same. In this year we are leading the foundation of the drone department in our AeroFCRIT and from the year 2023-24, AeroFCRIT is going to participate in two departments i.e., Fixed wing (planes) department and Multirotor (drone) department. We also collaborated with DRONACHARYA i.e., a group of industry experts that provide drone solutions across multiple domains, and organised a webinar for giving information about the use of multi-rotors in today's industry. In March, 2022 our club organised a national level drone racing event known as IDRL (Indian Drone Racing League) in our college. This event was organised in our college fest, ETAMAX and was the first event of IDRL to be held at Navi Mumbai. A total of around 25 pilots from all over India participated in the event. This event was a grand success of ETAMAX and got our club the recognition it deserved.

Team Thestral secured AIR 1 (Overall performance) in SAE Autonomous Drone Design Challenge (ADDC) 2023 held in Chennai from 25-26 August 2023. Despite of being newly-formed, the team members excelled in GCS, Avionics, Design & Manufacturing under the captaincy of Saurabh Kaduskar resulting in this remarkable achievement in the 1st year of foundation itself.

COUNCIL OF VIBRATION SPECIALISTS INDIA

Council of Vibration Specialists (CVS), a non- profit organization (first of its kind in the country exclusively on Vibration) has been formed by few expert professionals dedicated in Vibration Science and Engineering, both from academia and industry in order to scale up the reach of this inter-disciplinary specialization. The CVS Students Chapters was formed with to plan and organize technical programs and activities, to provide a common platform for the student members to exchange ideas and information, to facilitate practical training / project work and to play a major role in development of human resources required in industries/research organizations through training and certification in various domains of vibration.

Celebrating our 1st anniversary CVS-FCRIT students chapter, we would like to start by congratulating our mentor Dr. Nilaj Deshmukh, Dean (Faculty) & Head (Mechanical Engineering) for being elected as first chairman of CVS, Mumbai Chapter.

Since the inception last year where the students' chapter was flagged off by wonderful inauguration ceremony, student chapter has been actively organising and was part of many events. Led by student president Mr. Nageshwar Avhad chapter organized a webinar "Career Opportunities as Vibration Specialist" delivered by Dr. Tarapada Pyne (Secretary and Director General, CVS). Motive of this webinar was to make students of second & third year mechanical engineering aware of the opportunities across the industries as vibration specialists and encourage students to consider vibration analyst as career option.

This year we got opportunity to host the "1st International Conference On Vibration Science, Engineering and Technology 2022", an annual conference organized by CVS. Entire student chapter was involved as a part of organizing team. During the conference the members of students' chapter as well as other students from the institute got the opportunity to know about the ongoing research in the field of vibration, condition monitoring and machinery diagnostics. They also got to interact with the experts in the field across the country as well as overseas.

In the month of June 2023, a FDP/Certificate course of 30 hrs on "Advance Maintenance Practice and Vibration Diagnostics" was organized in association with CVS (Mumbai Chapter). Faculties from the institute and experts from outside the campus conducted sessions related to maintenance engineering, fault diagnosis, structural heath monitoring etc. Also, hands on sessions were conducted which gave practical insights. Around 29 faculties and students from various colleges undertook this very first training programme organized. We also had a grand celebration of 1st anniversary followed by the inception of new students' council on 26th April 2023.

INDIAN INSITUTE OF WELDING

The Indian Institute of Welding (IIW-India) was incorporated on 22nd April 1966 at erstwhile Calcutta to foster the development of welding science, technology, and engineering in India, and since then has been serving to the cause of welding industry. It has 13 Branches, 2 Centres and several Students' Chapters throughout India. The Institute is a not-for-profit organization registered under Section 25 of the Companies Act 1956 (presently Section 8 of the Companies Act 2013) and is also registered under section 12A of the Income Tax Act 1961, as an Institution for charitable purpose. Through its various activities and programmes, IIW-India is now recognized as the premier professional Institute related to welding in the country, with over 4500 Individual and Corporate Members. Furthermore, as a member society of the International Institute of Welding (IIW), it is helping to project the importance and achievements of the Indian Welding Industry to the global community. IIW-India is also a member of Asian Welding Federation (AWF) since its inception.

On becoming a member of IIW-India, one joins the wide fraternity of welding professionals in India both at the National and International levels. The various seminars, conferences, workshops and technical lectures organised by the Institute not only provide platforms for exchange of technological knowledge and information but also serve as forums for establishing contacts and information with professionals on one's chosen field.

The Indian Institute of Welding Students chapter is formed under the Department of Mechanical Engineering Fr. C. Rodrigues Institute of Technology. The Indian Institute of Welding Students chapter was inaugurated on 5th August 2023 with admired presence of Mr R. Srinivasan, Dr. Archana Sharma, Mr. Abby.K. Joseph, Mr. N Kanagasabai, Mr V.V. Kamath, Dr. S.M. Khot, Dr. Nilaj Deshmukh, Dr. Krishnan Sivaraman. During the Inaugural ceremony the importance and evergreen future of research in the field of welding was presented and conveyed to the fellow student members.

IIW has a the Fronius India solution & skill Centre, which provides students with state-of-the-Art lab facilities, where students can perform various welding and research related activities. The lab is also equipped with a KUKA robotic welding arm and various other facilities for students.

FACULTY PROFILE

Sr No	Name of the professor	Designation	Qualification	Area of specialization
1	Dr. S. M. KHOT	Principal	Ph.D. (IIT Bombay) – Aerospace Engineering	Professor (Exp - 33 years) Area of Research - Mechanical Vibration Dynamics and Control, Active Vibration Control, Smart
2	Dr. NILAJ DESHMUKH	H.O.D	Ph.D. (IIT Bombay) – Aerospace Engineering M. Tech. (VJTI, Mumbai)	Associate Professor (Exp. - Industrial 2 years, Teaching - 22 years) Area of Research - Virtual instrumentation Combustion, Combustion Instabilities, Measurement Techniques, Noise Analysis, Aerodynamics
3	Mr. T. MATHEWLAL	Associate Professor	M. S. (BITS, Pilani) B. Tech. (Mechanical)	Area of Research - Engineering Mechanics and Thermal Engineering
4	Dr. AQLEEM SIDDIQUI	Associate Professor	Ph.D. (Mumbai University) M. E. (Mumbai University)	Area of Research - Active Vibration Control, Automobile Dsgn

FACULTY PROFILE

5	Dr. DHANANJAY PANCHAGADE	Associate Professor	Ph.D. (Auburn University, USA) M.S. (Wayne State University, USA)	Area of Research - Machine Design
6	Dr. KRISHNAN SIVARAMAN	Associate Professor	PhD (IIT Bombay) ME (PSG College of Technology, Coimbatore)	Welding/ Mechanical
7	Mr. NANAJI KSHIRSAGAR	Assistant Professor	Ph.D. Pursuing, M. Tech. (VJTI Mumbai)	Design, MEMS, Synthesis of Mechanism
8	Mr. PRASAD BARI	Assistant Professor	Ph.D. Pursuing (VJTI, Mumbai) M. Tech. (VJTI, Mumbai)	Micromachining
9	Dr. SANJAY RUKHANDE	Assistant Professor	Ph.D. (VJTI, Mumbai) M.E. (SPCE Mumbai)	Design, Analysis, Finite Element Method, Surface and Coating
10	Ms. SHAMIM PATHAN	Assistant Professor	Ph.D. Pursuing (IIT, Bombay) M.E. (Mumbai University)	Vibration Measurement, Condition Monitoring and Fault Diagnosis
11	Mr. BIPIN MASHILKAR	Assistant Professor	M. E. (Mumbai University) - CAD/CAM and robotics	CFD

FACULTY PROFILE

12	Ms. PALLAVI KHAIRE	Assistant Professor	Ph.D. Pursuing (VJTI, Mumbai) M. E. (Mumbai University)	Mechanical Vibration, Machine, Design and Condition Monitoring
13	Mr. PRASEED KUMAR	Assistant Professor	M. E. (Mumbai University)	Active Vibration and Control, Control Systems, Smart Materials and Measurement
14	Mr. KAMLESH SASANE	Assistant Professor	M. E. (Mumbai University)	Design Analysis, Mechanical Vibrations, Automobile and Mechanical Materials
15	Mr. DEEPAK D.	Assistant Professor	M.E (Old Dominion University, US)	Manufacturing, Production,Solar
16	Mr. NILESH VARKUTE	Assistant Professor	M.E (Mumbai University)	Computational Fluid Dynamics, Heat Transfer, Renewable Energy and Energy Management
17	Ms. SUVARNA RODE	Assistant Professor	M. E. (Mumbai University)	CAD/CAM, Smart Material and Structures

FACULTY PROFILE

18	Mr. BADAL KUDACHI	Assistant Professor	M. Tech.(VTU, RC, Mysore)	Renewable, Thermal Barrier Coating, CFD and Energy Storage
19	Mr. MOHAMMOD AFZAL ALAM ANSARI	Assistant Professor	M. Tech. (IIT Bombay)	Propulsion, CFD, FEA, Combustion, Thermoacoustic
20	Mr. AMAR MURUMKAR	Assistant Professor	M. E. (Mumbai University) -	Quality, TQM, Six Sigma and Cost of Quality
21	Dr. BHARAT S. KALE	Assistant Professor	Ph.D (University of Mumbai) M.Tech (Government College of Engineering, Amravati)	Thermal Engineering, Viscous Fingering
22	Dr. VISHAL SALUNKE	Assistant Professor	PhD (Shivaji University, Kolhapur), M.E.ADCET, Shivaji University, Kolhapur)	Vibration Analysis and Condition Monitoring, Tribology, Rotodyanamics
23	Mr. SHOUMIK KULKARNI	Assistant Professor	M. Tech. (WCE)	Mechanical Vibrations, Vibro-Acoustics

FACULTY PROFILE

24	Mr. SUNNY SARRAF	Assistant Professor	M. Tech. (VNIT)	FEA, CAD CAM, 3D Printing and Bio-modelling
25	Ms. NEHA PANDIT	Assistant Professor	M. E	Heat Power Engineering, Thermal Engineering, Cryogenics
26	Mr. VARAD DESHPANDE	Assistant Professor	M. E.	Machine Design
27	Mr. JWESHVARI TUPE	Assistant Professor	M. E. (Mumbai University)	CAD/CAM and Robotics
28	Mr. KISHOR MANE	Assistant Professor	M. Tech (Dr. B.A.T. University) B. Tech (Dr. B.A.T. University)	Thermal Engineering
29	Mr. SYED MOHAMMED ARIF	Assistant Professor	M. E. (Mumbai University)	Automobile Engineering
30	Mr. JAVED KAZI	Assistant Professor	M.E (Dr. Babasaheb Ambedkar Technological University Lonere)	Thermal & Fluid Engineering with RAC

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