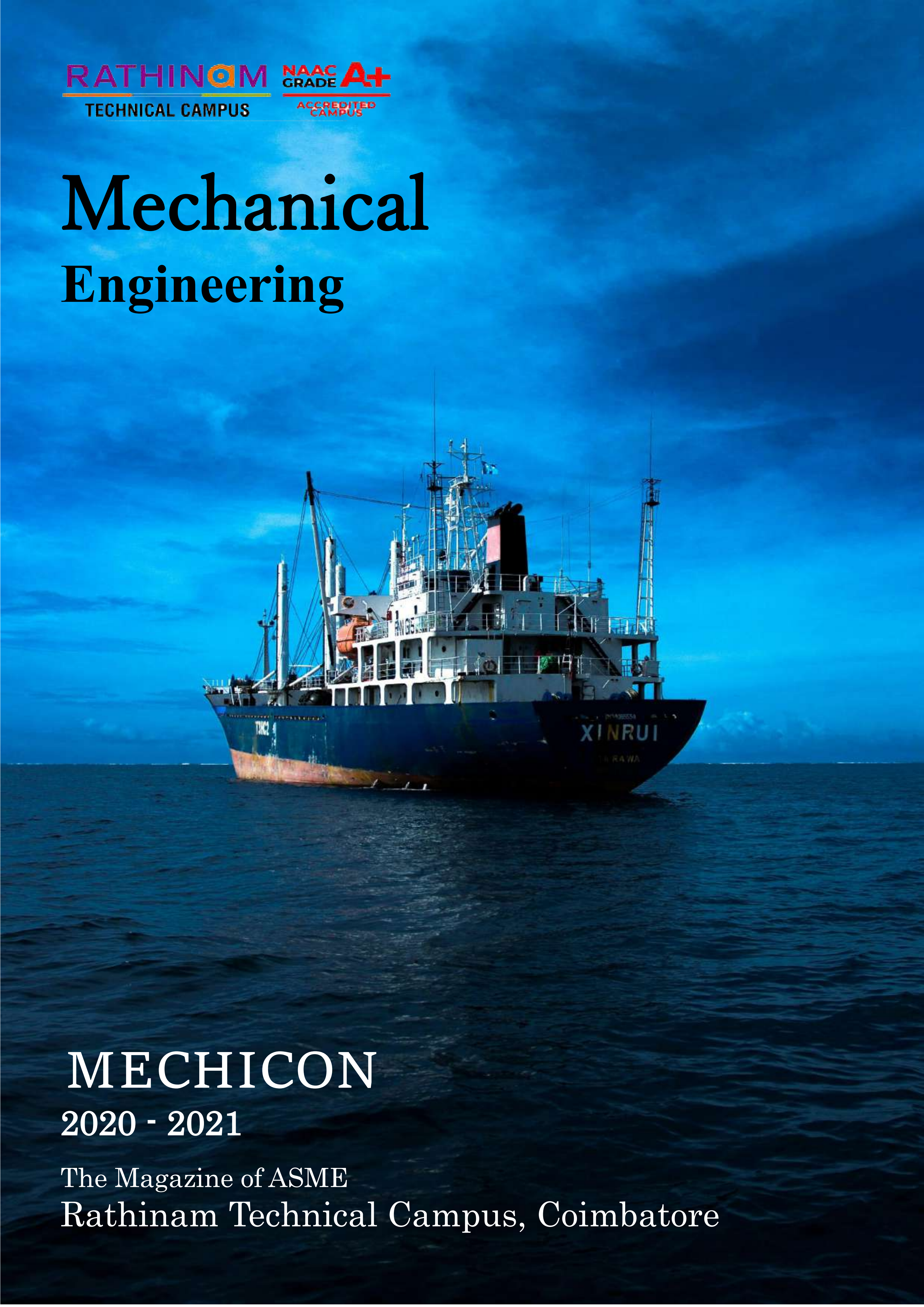
RATHINAM TECHNICAL CAMPUS

NAAC GRADE A+ ACCREDITED CAMPUS

Mechanical Engineering



MECHICON

2020 - 2021

The Magazine of ASME

Rathinam Technical Campus, Coimbatore

Dr. Madan A. Sendhil

Chairman, Rathinam Group of Institutions

Welcome to Rathinam Technical Campus, where we empower students to become the leaders of tomorrow. We believe that education is not just about learning facts and figures, but about shaping individuals who can make a positive impact on the world. Our approach to education is unique, as we focus not only on academic excellence but also on fostering creativity, innovation, and a sense of social responsibility.

Our modernized facilities, experienced faculty, and innovative teaching methods enable students to gain the knowledge and skills they need to excel in their chosen fields. We encourage students to think beyond the classroom and participate in various co-curricular and extra-curricular activities that help them develop their personalities and discover their true potential.

At RTC, we are committed to providing our students with a holistic education that prepares them for the challenges and opportunities of the 21st century. We aim to create a community of lifelong learners who are dedicated to making a positive difference in the world. Join us and unlock your potential today!

VISION OF THE INSTITUTE

To be a leading and path-breaking Institution in multi-disciplinary education, research, and industry-related development for meeting the challenges of a New India.

MISSION OF THE INSTITUTE

M1. Provide quality Engineering Education, Foster Research and Development, inculcate innovation in Engineering and Technology through state-of-the-art infrastructure.

M2. Nurture young men and women capable of assuming leadership roles in society for the betterment of the country.

M3. Collaborate with industry, government organizations, and society for curriculum alignment and focused, relevant outreach activities.

Dr. B. Nagaraj M.E., Ph.D., MIEEE, MSEEE, MIIOT, MIPSES, MIEEC.,

Principal, Rathinam Technical Campus

As we embark on a journey of higher education, we must remember that it is not just about textbooks and assignments, but also about excelling in every aspect of life. The world around us is in a constant state of transformation, and it is imperative that we equip ourselves with the necessary skills and knowledge to adapt and thrive in this rapidly changing landscape.

At our institution, we are committed to providing our students with a holistic education that not only hones their technical abilities but also instills in them the values and principles necessary to succeed as compassionate and ethical professionals. Our unique approach, rooted in the principles of Design Thinking, empowers our students to think critically, creatively, and empathetically, ensuring that they are not just proficient in their chosen fields but also equipped to make a positive impact on society.

We believe that education is not just a means to an end but a lifelong pursuit, and we encourage our students to keep their passion for learning alive by embracing the concept of "JUST LOVE YOURSELF". By prioritizing personal growth, celebrating life's moments, and nurturing our conscience, we can create a better future for ourselves and those around us. Let us come together and embrace this journey of self-discovery and transformation.

Dr. B. Nagaraj

Dr. M. Rajasankar M.E., Ph.D.,

HEAD OF THE DEPARTMENT

The department of Mechanical Engineering aims to provide a strong foundation in the fundamentals of Mechanical Engineering. The basic knowledge of analysis as well as the knowledge of the principles on which Mechanical Engineering is based taught through the theory and laboratory classes by a strong team of well qualified and experienced teaching staff and the technical support staff. The department also strives to instill the engineering temper and the spirit of enquiry in students. It encourages the students to understand and therefore apply the laws through the laboratory classes.

The department has well equipped laboratories such as Basic Workshop Lab, Machines Shop Lab, Computer Aided Machine Drawing Lab, Mechanical Measurements Lab, Material Testing Lab, Heat Transfer Lab, Energy Conversion Lab, Fluid Mechanics & Machines Lab, Heat & Mass Transfer Lab, Design Lab, Computer Aided Analysis Lab to perform the practical's to understand the concepts.

The department provides its students with a number of opportunities to develop their overall personality by participating in the various curricular, co-curricular and cultural activities held throughout the year .The students with the directions from faculty members of the department take very active part in organizing these activities.

Dr. M. Rajasankar

VISION OF THE DEPARTMENT

To emerge as a leading influence in Mechanical Engineering education, research, and advancements driven by industry, making a substantial contribution to the transformative growth of the Nation.

MISSION OF THE DEPARTMENT

M1 : Deliver top-tier Mechanical Engineering education, promote a culture of research and innovation, and leverage state-of-the-art infrastructure to stay at the forefront of Engineering and Technology.

M2 : Nurture future leaders in Mechanical Engineering, empowering them to take on pivotal roles in society and contribute significantly to the nation's advancement.

M3 : Foster dynamic collaborations with industry, government bodies, and society, ensuring curriculum alignment with evolving industry needs and engaging in targeted outreach activities to bridge the gap between academia and industry for mutual growth..

Program Educational Objectives (PEOs)

PEO NO.	PROGRAM EDUCATIONAL OBJECTIVES STATEMENTS
PEO 01	Graduates will have professional & technical career in mechanical and inter disciplinary domains providing innovative and sustainable solutions using modern tools.
PEO 02	Graduates will have effective communication, leadership, team building, problem solving, decision making and creative skills.
PEO 03	Graduates will practice ethical responsibilities towards their peers, employers, and society

Program Outcome (POs)

PO1 - Engineering Knowledge

PO2 - Problem analysis

PO3 - Design / Development of Solutions

PO4 - Conduct Investigations of Complex Problems

PO5 - Modern Tool Usage

PO6 - The engineer and society:

PO7 - Environment and Sustainability

PO8 - Ethics

PO9 - Individual and Team work

PO10 - Communication

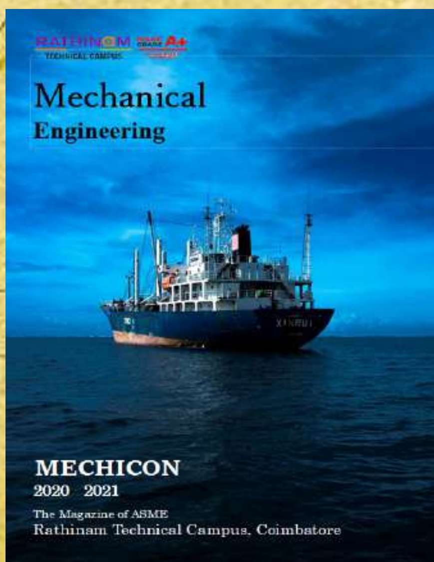
PO11 - Project Management and Finance

PO12 - Life-long Learning

Program Specific Outcome (PSOs)

PSO NO.	PROGRAM SPECIFIC OUTCOMES (PSOs)
PSO 01	Application of Mechanical Engineering concepts to solve Engineering problems using modern tools and techniques.
PSO 02	Identify and recommend alternative Engineering methods and materials for sustainable development.

CONTENTS



COVER PAGE

EDITORIAL MEMBERS

EDITORIAL MEMBERS

Six emerging technologies that will drive advancements in the next decade

Engineers possess a natural curiosity about the mechanics of things, propelling the field of engineering to explore new ideas and solutions. During the COVID-19 lockdowns, as the world shifted towards a more digital existence, engineers encountered a steep learning curve. They needed to quickly develop, integrate, and scale digital technologies and components to meet new global demands.

This digital shift during the pandemic coincided with the emergence of technologies from the fourth industrial revolution. Technologies like digital twins, which were already valuable for saving time and resources before 2020, became essential for designing and testing as engineers began conceptualizing designs remotely.
Here are six emerging technologies that will drive advancements in the next decade.

Diving into Digital

As pandemic life becomes the norm, the emphasis on expanding digital capabilities across fabrication, logistics, and customer service will continue to drive growth in mechanical engineering.
IBM's 2021 Digital Transformation Assessment revealed that 67 percent of manufacturers accelerated digital projects due to the pandemic. Key projects highlighted by respondents included:

- Development of new digital design tools
- Creation of automation programs for manufacturing, logistics, and service systems
- Strengthening remote work and collaborative software platforms and applications

The same IBM assessment also estimated that nearly 44 percent of the skills needed to succeed in an engineering career will change within the next five years, even for those currently employed as engineers.
Even more surprising, the WEF's "The Future of Jobs Report 2020" indicated that almost 50 percent of all employees will need digital upskilling by 2025.

Merging the Mechanical and the Digital

As part of the broadest engineering discipline, mechanical engineers are uniquely positioned to benefit from the digital revolution.
While AI, robotics, and additive manufacturing are expected to be the primary technologies driving all fields of engineering over the next decade, software and electrical engineers often need support from mechanical engineers to bring their designs to life.

This surge in interdisciplinary engineering promises job growth for mechanical engineers, but it will also necessitate industry-wide investment in continuing education for everyone, from new graduates to mid-career professionals to senior specialists.

Additive manufacturing

The flexible, on-demand production capabilities of additive manufacturing (AM), or 3D printing, made AM a key factor in overcoming supply chain issues during the first year of the pandemic.

In line with global trends, the use of sustainable materials will also continue to be important. The introduction of recyclable polymers and the increased utilization of technical ceramics manufacturing, as well as advanced metal printing technologies, will transform AM usage in the aerospace and medical sectors.

With the global market for AM projected to reach $51 billion by 2030, mechanical engineers will benefit from improving their design for additive manufacturing (DfAM) skills at any stage in their careers, even in industries without prevalent AM use.

CAD/CAM

Computer-aided design (CAD) and computer-aided manufacturing (CAM) have been around for a while, but their applications have evolved significantly. CAD software has long enabled engineers to conduct virtual stress tests, run performance simulations, and automate electronic designs.

Today, CAD is also being utilized for additive manufacturing, generative design, digital twinning, and more. With cloud technology, engineers can now perform these tasks from anywhere.

Another exciting development is the effort to create a unified CAD/CAM standard, which would facilitate seamless data transfer across various platforms and programs. If successful, all mechanical engineers will need to learn and adhere to these new and improved standards.

Digital Twins

Digital twins enable mechanical engineers to virtually test products and control equipment or tools from different companies. They also facilitate the creation and testing of numerous complex digital twin designs across various industries.

With major cloud providers like Microsoft, Google, and AWS expanding their digital twin capabilities over the past two years, it's likely that digital twin technology will transition from add-on Infrastructure as a Service (IaaS) tools to native Platform as a Service (PaaS) systems. When this shift occurs, organizations will find it much easier to integrate digital twinning on any platform.

Another advantage of digital twin technology is its ability to create accurate, predictive maintenance and lifecycle schedules, allowing engineers to proactively adapt their plans and designs.

Automation & Smart Systems

The gap between old and new technologies is now wider than ever, making the retrofitting or upgrading of legacy equipment and systems increasingly complex.

While obtaining a second degree in software engineering isn't necessary, updated programming skills and a strong understanding of advanced mathematics are essential to bridging this technological divide.

Additionally, many components in these systems will be designed by mechanical engineers. A solid grasp of materials, robotics, and mechatronics, along with the ability to collaborate with electrical and software engineers, will be crucial as engineering becomes more cross-functional.

Green Engineering

As climate change and resource depletion continue to impact the planet, traditional mechanical engineering technologies, such as internal combustion engines, are being scrutinized more closely.

To succeed in the future, engineers must adopt green engineering technologies. According to the EPA, green engineering involves the "design, commercialization, and use of processes and products in a way that reduces pollution, promotes sustainability, and minimizes risk to human health and the environment without sacrificing economic viability and efficiency."

Future mechanical engineers will need to:

- Protect natural resources while developing reusable ones
- Reduce energy consumption or work with renewable energy sources
- Consider and minimize pollutive output and waste in manufacturing.

Internet of Things (IoT) & Industrial Internet of Things (IIoT)

In 2021, nearly 27.1 billion devices were connected to the Internet of Things (IoT), and this number is expected to continue growing.

This expansion has also led to the rise of the Industrial Internet of Things (IIoT), which involves networking and connecting industrial equipment, sensors, machines, and other instruments to each other and to the internet.

The IIoT emphasizes enhancing machine-to-machine communication and machine learning to improve the efficiency and accuracy of various engineering operations, including:

- Time-to-market design and production
- Quality control
- Tracking production bottlenecks
- Supervisory controls

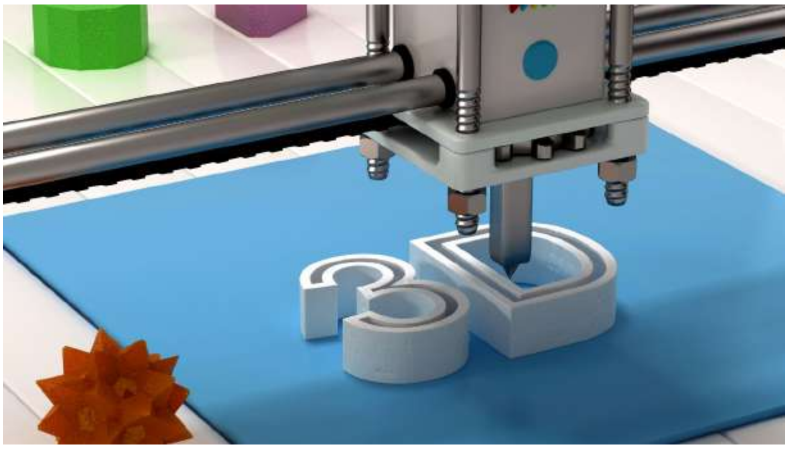
SURESH B
721818114051 **III Year**

Blending the Mechanical and Digital

Mechanical engineering plays a crucial role in all aspects of life, from the construction of vehicles to the facilities we use at home and work, impacting us directly or indirectly in every facet

AI, robotics, and additive manufacturing are likely to be the primary technologies driving advancements across all engineering disciplines in the coming decades. Software and electrical engineers often rely on the support of mechanical engineers to bring their concepts to fruition.

The expansion of additive manufacturing, commonly referred to as 3D printing, is revolutionizing global manufacturing practices by promoting the development of sustainable materials and adaptable systems for on-demand production.



The global 3D printing market is projected to exceed $51 billion by 2030, underscoring its sustained growth beyond 2023. Additive manufacturing has proven indispensable in aerospace, facilitating the construction of spacecraft crucial for space exploration, including efforts to colonize the Moon, Mars, and beyond.

Computer-aided design (CAD), long utilized by mechanical engineers, has evolved beyond traditional design functions. It now serves diverse roles such as performance simulations, stress testing, generative design, and digital twinning. This evolution promises novel applications as engineers harness newer versions of CAD in the years ahead.

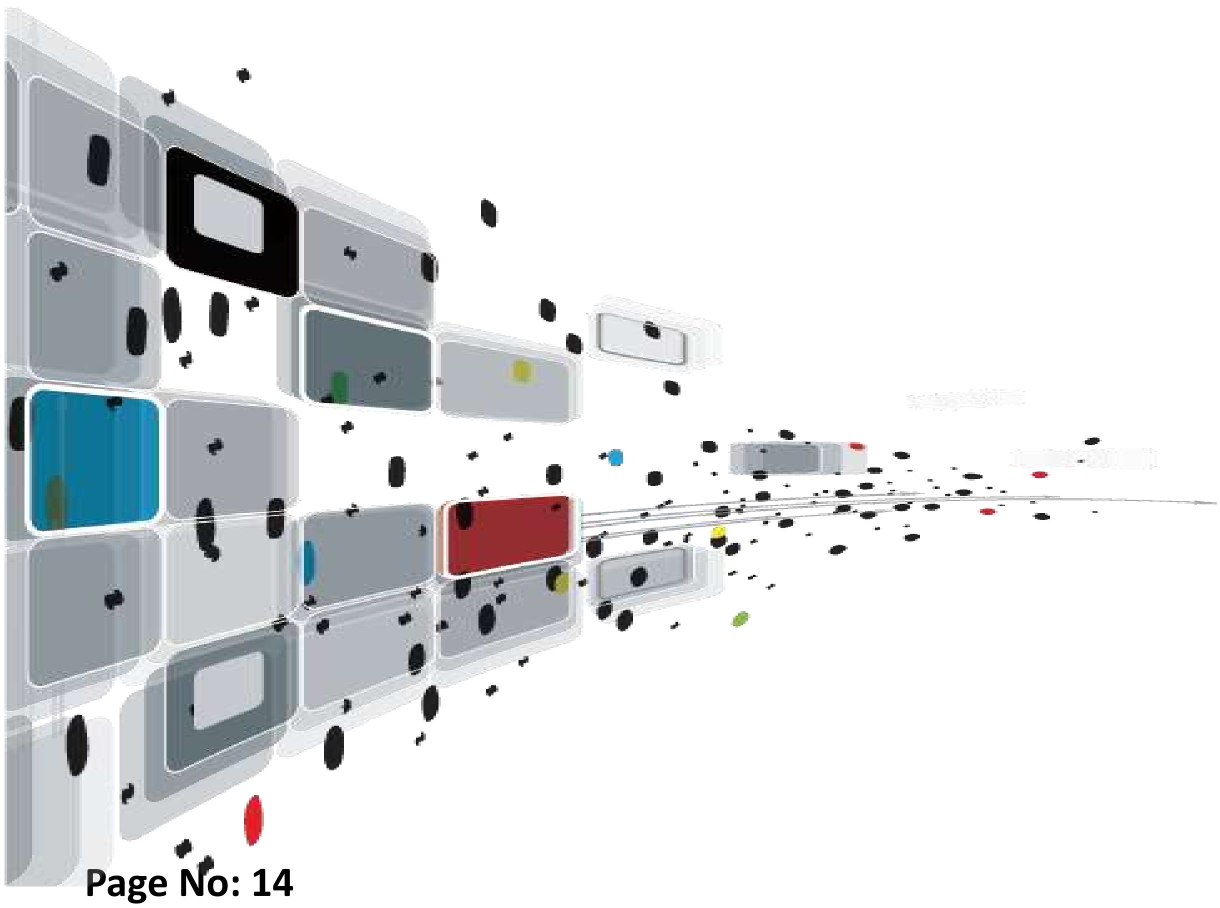
Digital twinning is increasingly adopted among engineers seeking to streamline prototyping processes. This technology creates virtual models that faithfully replicate physical items, reducing the reliance on physical prototypes during project development.

AKKESH.V
721819114301 **II Year**

Adopting Digital Twin Technology

Engineers frequently struggle with managing numerous prototypes and physical models when making minor design modifications. Digital twinning is becoming increasingly popular as a solution to reduce the need for multiple physical prototypes. A digital twin is a virtual model that precisely mirrors an object in the physical world.

A digital twin can be outfitted with virtual sensors, enabling mechanical engineers to conduct stress and performance tests on their products without needing a new prototype for each test. The data gathered in the digital realm can be utilized to refine and perfect the physical counterpart.



NITHEESH N
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III Year

TRANSFORMING THE TOOLBOX

EMPOWERING FUTURE MECHANICAL ENGINEERS WITH AI AND MACHINE LEARNING

SHOOTING FOR THE STARS

WORKING IN A GALAXY FAR, FAR AWAY

"AI and machine learning are ubiquitous and exciting technologies and I view them as important tools for mechanical engineers.

With these tools, mechanical engineers can take their work to the next level, to better understand physical phenomena and to develop a better device."

AI and machine learning are new tools that are not going away, and they will help to inform engineers how to do their jobs better.

AI and machine learning are ubiquitous and exciting technologies. We view them as critical tools for the next generation of mechanical engineers, Allen Robinson, head of mechanical engineering. "Our department is pioneering the use of these tools to better understand physical phenomena and to develop superior products, from surgical devices to autonomous vehicles.

While AI and machine learning are often associated with computer science, their true impact only occurs when they are translated into the physical world, he added. This translation is the role of mechanical engineers. We are the physical connection, using these technologies to solve real-world problems.

In the curriculum, given the growing importance of AI and machine learning, the Department of Mechanical Engineering is teaching both graduate and undergraduate students how these technologies complement and extend existing physics-based models. A sampling of courses includes:

- Artificial intelligence and machine learning — project course
- Machine learning and artificial intelligence for engineers
- Bayesian machine learning for scientists and engineers
- Deep learning for engineers

AI and machine learning are new tools that are not going away, and they will help to inform engineers on how to do their jobs better," said Jonathan Cagan, professor of mechanical engineering.

They will need to understand AI and machine learning, which will be embedded in the methods and techniques they use.

A Pioneer Among Peers Solving the world's biggest challenges requires collaboration among many partners, and preparing the next generation of mechanical engineers happens at many universities. While Carnegie Mellon is already integrating AI and machine learning tools into its curriculum, many departments at peer institutions have not yet reached this point. Recognizing this, Robinson teamed up with Evelyn Wang, the mechanical engineering department head at the Massachusetts Institute of Technology (MIT), to co-organize and co-moderate a panel on the topic for department heads and chairs at peer institutions.

STUDENTS' ARTICLE

Working in a Galaxy FAR, Far Away

For some people, work means beige cubicles and boredom. For Carnegie Mellon alumna Sophia Acevedo, however, work means distant planets and DJ droids. Acevedo isn't an astronaut or a fiction author; she is an Imagineer who worked on Disney's Star Wars-themed land, Star Wars: Galaxy's Edge.

Long before joining Disney, Acevedo was passionate about physics and engineering. During her senior year of high school, she sent her resume to NASA's Jet Propulsion Laboratory "on the off chance that they needed someone to do work that no one else wanted to do, Acevedo recalls. This led to an internship the summer after her senior year, which opened doors for her future roles. Over the years, she transitioned into more technical positions, eventually working with the cryogenic physics group.

After graduating from Dickinson College, Acevedo pursued graduate studies in mechanical engineering at Carnegie Mellon. Her classes provided her with valuable knowledge and clarity about her career path. All of my project-based courses were formative in figuring out what my next step would be, Acevedo says. I started to see myself in a role that was more about guiding the process than being the engineer doing the design work. She found the Mechatronic Design course, taught by Matthew Travers and Cameron Riviere, particularly helpful.

During her final year at Carnegie Mellon, Walt Disney Imagineering (WDI) held a session in the Mech

E graduate student lounge. As soon as I saw Imagineering was coming to talk to us, I knew I had to go,Acevedo says. I was born and raised in Los Angeles, so I grew up going to Disneyland all my life. At the session, she made a connection, got a business card, and followed up with her application.

Fortunately, the force was with her. Acevedo began her role at WDI as a project controls planner in June 2016. As a project planner, she works with mostly technical teams to plan and strategize their scope from a design, production, and installation perspective.

To her delight, Acevedo was immediately assigned to work on Star Wars: Galaxy's Edge, a Star Wars-themed land that opened at both Disneyland and Walt Disney World in 2019. The area was set on a 'never before seen planet called Batuu, Acevedo explains, "a remote trading port and one of the last stops before you enter wild space. The land features a market, a cantina, two signature attractions, and more.

BHARATH KUMAR.A.N
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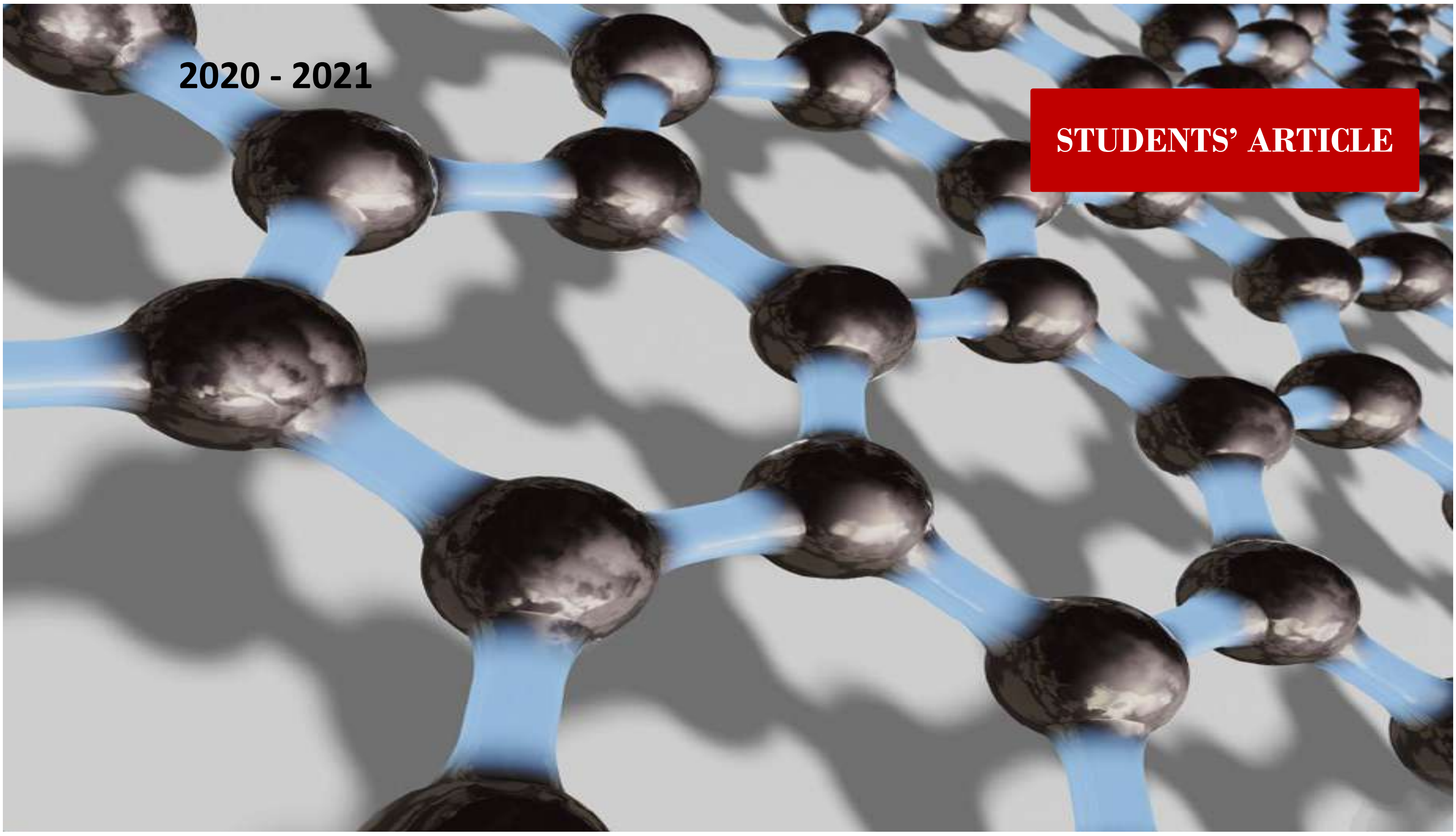
II Year

STUDENTS' ARTICLE



Advanced Materials

Manufacturing companies tend to favor tried-and-true materials for their products since these materials are already validated, with well-studied chemical and mechanical properties. However, product performance and functionality can often be enhanced with new materials that, once tested and approved, offer highly specific engineered properties. These materials can significantly improve product performance and open up new design possibilities. Below are some innovative materials that could transform manufacturing in the near future.

1. Titanium Fluoride Phosphate

Researchers at the Skoltech Center for Energy Science and Technology in Moscow have developed titanium fluoride phosphate as a new cathode material. This material boasts a strong electrochemical potential and stability at high charge/discharge currents, outperforming the standard cathode materials of lithium and cobalt, which are both expensive and increasingly scarce.

2. **Cellulose Nanofibers**

The KTH Royal Institute of Technology in Sweden has developed a super-strong, biodegradable material made from cellulose nanofibers derived from wood. Its unique nanostructure provides a tensile stiffness of 86 gigapascals and a tensile strength of 1.57 gigapascals, making it eight times stiffer than spider silk, which is considered the strongest biomaterial, and stronger than steel on a weight basis. This lightweight material has the potential to be an eco-friendly alternative to plastic.

3. Self-Healing Gel

A gel material composed of aminopropyl methacrylamide (APMA) polymer, glucose, glucose oxidase, and chloroplasts continuously reacts with carbon dioxide from the air, causing it to expand and strengthen over time. It is the first carbon-fixing material to exist outside of biological organisms. Creating a material that can utilize the abundant carbon around us presents a significant opportunity for materials science.

4. Platinum-Gold Alloy

Researchers at Sandia National Laboratories have developed a gold-platinum alloy that is 100 times more abrasion-resistant than high-strength steel, even at high temperatures. The material's exceptional thermal stability is achieved by altering the grain boundary energies. Under stress, the alloy generates its own diamond-like carbon, which acts as a lubricant.

AMAL RAJ T
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III Year

5. Composite Metal Foams

Composite metal foams (CMF) are made up of hollow metallic spheres, crafted from materials like steel or titanium, embedded in a metallic matrix, typically made of steel or aluminum. Tests have shown that "steel-steel" CMF—where both the spheres and the matrix are made of steel—is significantly more fire-resistant than a solid steel plate. Additionally, the steel-steel CMF panel weighs only one-third of what a solid steel plate does. Consequently, CMFs are considered a promising material for protecting heat-sensitive items, such as explosives, during transportation and storage.

6. Spider Silk

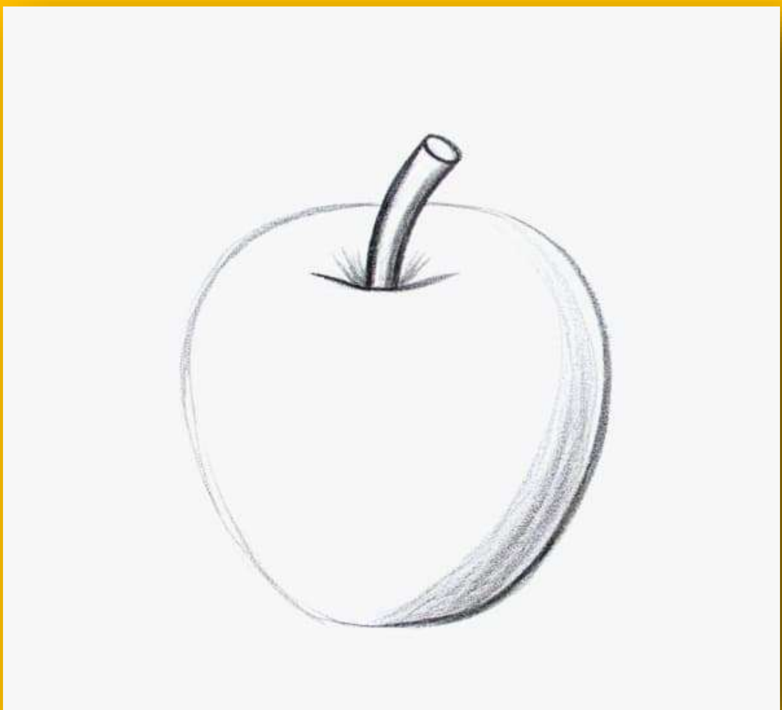
Spider silk is already considered one of the strongest materials in the world. Now, scientists have discovered another unique mechanical property: above a certain humidity level, spider silk fibers suddenly contract and twist. This process, known as super-contraction, generates enough torsional force to potentially compete with other materials used in actuators or other control devices.

7. Shrilk

Inspired by insect exoskeletons, researchers at Harvard University's Wyss Institute for Biologically Inspired Engineering have developed "shrilk," a biodegradable "plastic." Made from chitosan, a component found in shrimp shells, and a silk protein called fibroin, shrilk is as strong as aluminum and 50 percent lighter. Its biocompatibility, flexibility, and strength make it an attractive material for implantable medical devices and tissue engineering.

8. Carbon Concrete

Researchers are exploring the reinforcement of concrete with carbon fiber to enhance its strength and durability. A major advantage of carbon is its resistance to oxidation. Unlike steel-reinforced concrete, which can rust and degrade, carbon does not require thick concrete layers for protection. Adding carbon to concrete increases its load-bearing capacity by five or six times compared to traditional steel



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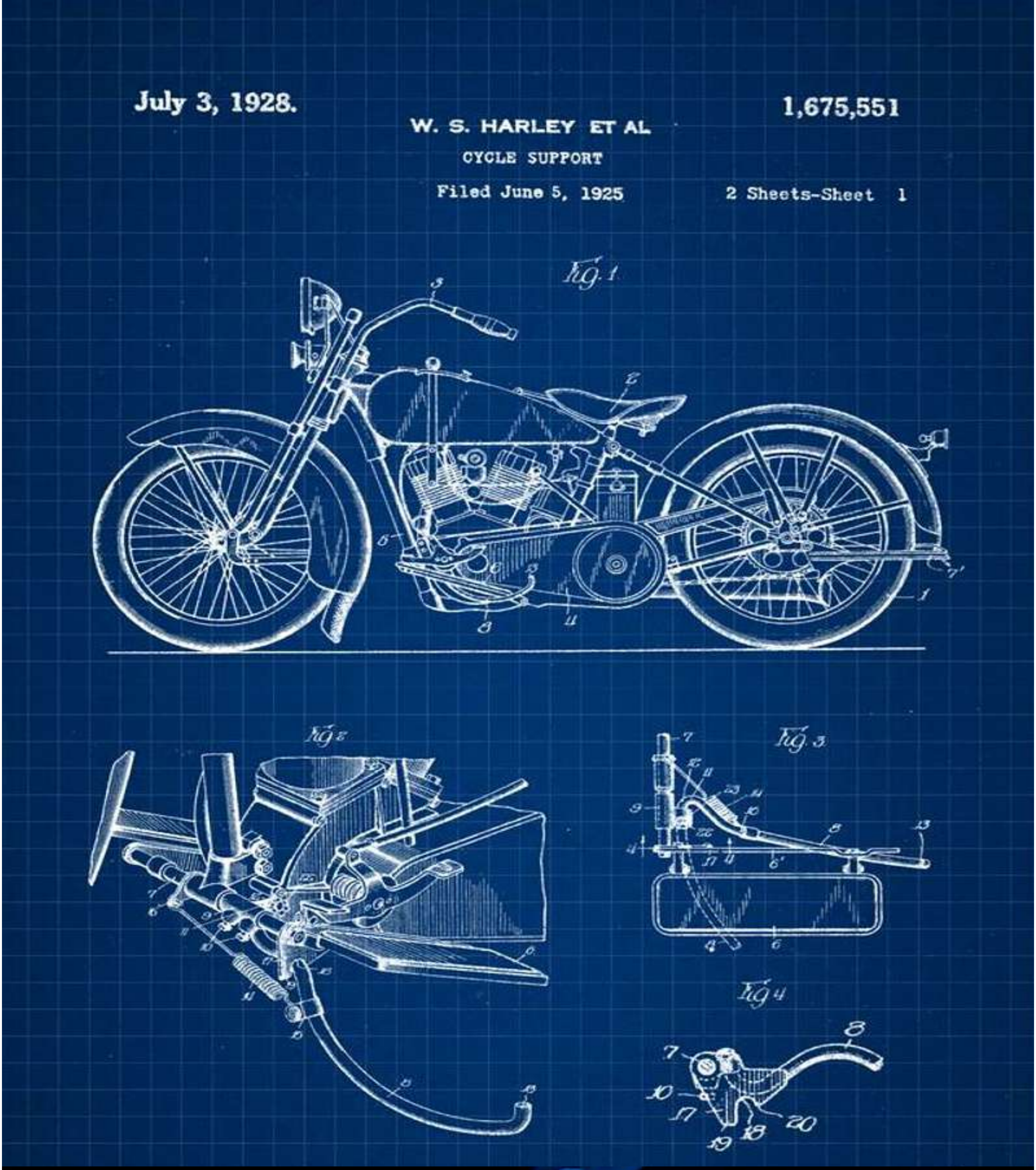

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