

# TECH-WIRED

Vol. 7 Issue.1

January 2026



**Five-Day Product  
Development Workshop**



**Educational Industrial  
Visit**



**National Seminar on  
ELECTRIC VEHICLE**



**EXPERT LECTURES**



**POSTER PRESENTATION**



<https://rrimt.ac.in/departments/departme-nt-of-electrical-electronics-engineering/>

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# FROM THE CHAIRMAN'S DESK



**Shri Anil Kumar Agarwal**  
**Chairman**

Congratulations to the Electrical Engineering Department on the successful publication of the latest issue of our Magazine! This edition is a true reflection of the department's dedication to excellence and cutting-edge research. I extend my heartfelt appreciation to our brilliant students and faculty members for their outstanding contributions to the field. Enjoy this inspiring read, and keep up the great work!

# FROM THE DIRECTOR'S DESK



**(Prof. (Dr.) Dr. Shailendra Singh Chauhan  
Director**

Greetings,

It gives me great pleasure to present this edition of the Electrical Engineering Department Magazine of R. R. Institute of Modern Technology, Lucknow. This publication highlights the academic strength, technical achievements, and innovative spirit of the department. It is not merely a record of activities, but a reflection of the dedication, creativity, and progressive thinking of our students and faculty members.

The Department of Electrical Engineering plays a vital role in shaping skilled professionals who are equipped to meet the evolving demands of technology and industry. At RRIMT, we emphasize quality education, practical exposure, innovation, and ethical values to ensure holistic development of our students. This magazine serves as a meaningful platform for sharing ideas, research insights, and creative expressions beyond the classroom.

I appreciate the efforts of the editorial team, contributors, and faculty members who have worked with commitment to bring out this publication. I am confident that this edition will motivate students to explore new possibilities, strengthen their technical knowledge, and strive for excellence in their chosen fields.

I wish all readers an informative, inspiring, and enriching experience.

# FROM THE HEAD OF DEPARTMENTS'S DESK



**Mr. K.P.YADAV**

**Assistant Professor and Head  
Dept. of Electrical Engineering**

It is with great pleasure that we welcome you to the Department of Electrical Engineering at RRIMT.

Our department is distinguished by a faculty of highly skilled and devoted professionals, most of whom hold degrees from India's premier universities and bring significant academic and industrial experience. We are dedicated to providing ample opportunities for professional development for all members of our community through targeted trainings, workshops, and external programs.

Furthermore, we are proud to introduce our new semester publication, "TECH-WIRED." This magazine is designed to cultivate enthusiasm, foster knowledge exchange, and promote an innovative spirit among students and staff alike.

# MESSAGE FROM MAGAZINE FACULTY COORDINATOR



It is my great pleasure to present the first issue of the 7th volume of 'TECH-WIRED,' the Odd-Semester magazine for 2025-2026.

My heartfelt congratulations go to the students of the ELECTRIX Society for taking the initiative and contributing to this edition. Magazines like this provide a wonderful platform for electrical engineering students to express their latent talents, ideas, and thoughts through articles, poetry, and reflections on life both inside and outside the campus. It is a powerful reminder that technical minds possess no less creativity when it comes to writing and philosophical expression.

The clean, green, and eco-friendly nature of this publication is a particularly commendable concept. Working with the editorial team and watching their creations take shape has been a wonderful experience.

I extend my sincere thanks to every contributor. Special gratitude is due to our Chairman, Director, Heads of Department, faculty members, and staff for their invaluable support.

I sincerely hope you enjoy reading this magazine.

# VISION

## INSTITUTE VISION

To achieve excellence in scientific, technical education, and research to create a dynamic and multidisciplinary system to make our students technically and professionally excellent with incorporation of Indian values, morals, and ethics.

## DEPARTMENT VISION

To emerge as centre of excellence in the field of electrical engineering to enhance the technical and professional skills of the students and make them competent enough to cater the multidisciplinary needs of the academia, industry and society with strong moral and ethical values.

# MISSION

## INSTITUTE MISSION

**M1-** To provide state of the art facilities, resources, and academic environment which creates competent professionals who can contribute to the development of society, nation, and world.

**M2-** To establish a perpetual institution-industry interaction to broaden student horizons and strengthen the multidisciplinary approach.

**M3-** To inculcate skills leading to employability and entrepreneurship with a passion for lifelong learning.

**M4-** To incorporate a healthy competitive zeal among the students with full of confidence to make them dynamic professionals, full of Indian values, morals, and ethics.

## DEPARTMENT MISSION

**M1-** To provide an environment for effective teaching-learning process with incorporation of multi-disciplinary approach to develop competent electrical engineers.

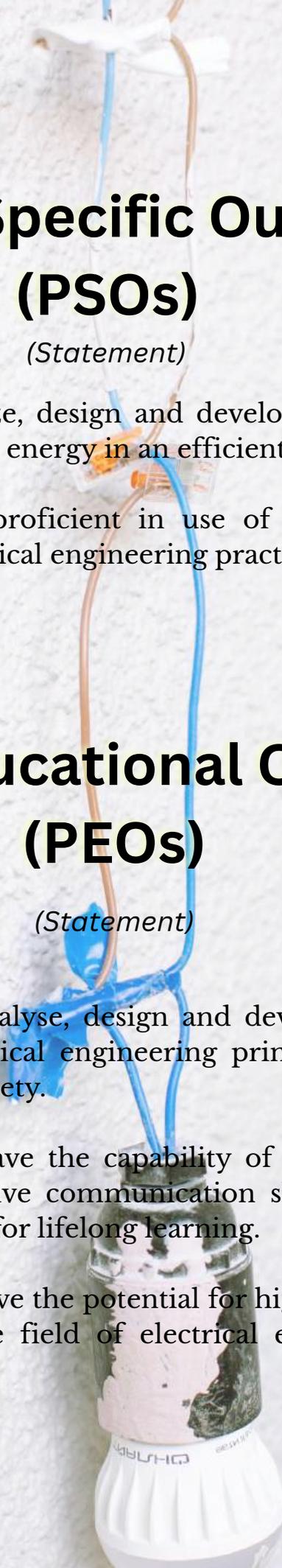
**M2-** To strengthen the students technically & professionally in electrical engineering domains using state of art technology which leads to successful employability, higher education and entrepreneurship.

**M3-** To foster an inspiring atmosphere which induces a passion for lifelong learning with incorporation of human values and ethics.

# PROGRAM OUTCOMES

*(Statement)*

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



# Program Specific Outcomes (PSOs)

*(Statement)*

**PSO1:-** The ability to analyze, design and develop systems that generate, transmit and utilize electrical energy in an efficient way.

**PSO2:-** The ability to be proficient in use of automation Technology required to implement electrical engineering practice.

# Program Educational Objectives (PEOs)

*(Statement)*

**PEO1:-**The graduates will analyse, design and develop tools, applications and systems based on electrical engineering principles to solve real life problems of industry and society.

**PEO2:-**The graduates will have the capability of working individually as well as in teams with effective communication skills, leadership quality, ethical values and an instinct for lifelong learning.

**PEO3:-** The graduates will have the potential for higher education, research and entrepreneurship in the field of electrical engineering and related domains.

# ABOUT DEPARTMENT OF ELECTRICAL ENGINEERING

The Electrical Engineering Department at R.R. Institute of Modern Technology, Lucknow stands out with its exceptional offerings:

- 1. Expert and Dedicated Faculty:** The Electrical Engineering Department at R.R. Institute of Modern Technology takes pride in its accomplished faculty, renowned for their leadership in specialized domains. Combining profound academic expertise with a student-centric approach, these educators deliver rigorous instruction and individualized mentorship, fostering both intellectual growth and practical skill development.
- 2. Departmental Commitment:** Our mission centers on cultivating future innovators in electrical engineering through a dynamic, interdisciplinary curriculum. By integrating theoretical foundations with hands-on learning and industry-aligned projects, we prepare students to navigate evolving technological landscapes and emerge as leaders in their careers.
- 3. Cutting-Edge Learning Infrastructure:** Our department features advanced laboratories and technology-enhanced classrooms outfitted with high-definition projection systems and interactive tools. These facilities are designed to bridge theoretical concepts with real-world applications, enabling dynamic, multisensory learning experiences. From experimental exploration in labs to collaborative problem-solving in smart classrooms, our infrastructure supports innovation and creativity.
- 4. Advanced Simulation Resources:** Aligned with evolving industry standards, our department integrates industry-leading simulation software and computational platforms into the curriculum. These tools empower students to engage in predictive modeling, digital prototyping, and real-time analysis of intricate electrical systems. By mastering these technologies, learners refine their troubleshooting expertise, develop critical thinking, and gain hands-on proficiency in designing solutions for tomorrow's engineering challenges.
- 5. Industry-Driven Curriculum Design:** Our program's academic framework is proactively revised to mirror advancements in electrical engineering, incorporating breakthroughs in automation, renewable energy, and smart systems. Through collaboration with industry partners, we embed cross-disciplinary insights and emerging sector demands into coursework. This agile approach equips students with a forward-looking skill set, fostering adaptability and empowering them to lead in a rapidly evolving technological landscape.

**6. Research-Intensive Ecosystem:** The department cultivates a culture of academic inquiry by embedding research at the core of the student experience. Through structured mentorship programs and collaborative projects, learners partner with faculty to explore pioneering innovations in areas such as smart grids, embedded systems, and AI-driven automation. These initiatives not only deepen theoretical understanding but also hone skills in experimental design, critical analysis, and scholarly communication—equipping students to contribute meaningfully to academic discourse and technological innovation.

**7. Dynamic Professional Development Initiatives:** The department facilitates experiential learning through curated knowledge-exchange platforms, including hands-on workshops, expert-led guest lectures, and industry immersion programs. Partnering with global academia and leading tech enterprises, these initiatives bridge academic and professional realms. Students gain insights into emerging domains like IoT integration and sustainable energy solutions, grounded in current industry practices. Direct engagement with thought leaders and cross-sector collaboration cultivates a multidimensional perspective, empowering graduates with an adaptive mindset and strategic networks to thrive in global engineering ecosystems.



At the Electrical Engineering Department of R.R. Institute of Modern Technology, we are dedicated to cultivating tomorrow's engineering leaders through a transformative academic ecosystem. By merging rigorous theoretical frameworks with industry-aligned projects, collaborative research, and multifaceted learning pathways, we equip students with the intellectual agility and adaptive expertise to pioneer solutions for global technological challenges. Our mission is to shape not just skilled professionals, but visionary innovators poised to drive sustainable progress in electrical engineering and beyond.



DEPARTMENTAL ACTIVITIES

W79+ 32f, Digo, Uttar Pradesh 226201, India  
Longitude: 80.91748666666666  
Latitude: 26.666666666666666  
Altitude: 123 meters  
Time: Wednesday, 19.11.2025 11:00 AM

# Expert Lecture on OUTCOME BASED EDUCATION

On August 27, 2025, at 10:00 AM, a comprehensive session on Outcome-Based Education (OBE) was conducted for all 121 Electrical Engineering students in Seminar Hall 1. Facilitated by Mr. K P Yadav, Head of the Department, and led by Dr. Shailendra Singh Chauhan, Director of RRIMT, the session aimed to familiarize students with the OBE framework. The objectives included understanding key components like Course Outcomes (COs), Program Outcomes (POs), and Program Educational Objectives (PEOs), learning the process of mapping COs to POs, and appreciating the role of OBE in academic and professional development. The session featured interactive lectures and demonstrations that covered the definition and importance of OBE, a comparison with traditional education, and detailed explanations of PEOs, POs, and COs specific to the Electrical Engineering curriculum. A step-by-step demonstration of CO-PO mapping using Bloom's Taxonomy was provided, along with an overview of assessment tools and feedback mechanisms for continuous improvement. An interactive Q&A allowed students to discuss practical applications and challenges. Key takeaways included a clearer understanding of how OBE links learning objectives to measurable outcomes, the importance of accreditation, and the encouragement of lifelong learning and problem-solving skills. Students provided positive feedback on the practical examples and suggested more hands-on exercises for future sessions. The event successfully enhanced students' awareness of OBE principles, which are expected to be applied in their academic projects and future careers.



## Expert Lecture on INDUSTRY 4.0

An expert lecture on Industry 4.0 was organized at RRIMT, Lucknow for the students of Electrical Engineering on 09.09.2025 at 2:30PM. The lecture was delivered by Dr. R. K. Upadhyay, Director, KNIT Sultanpur, a distinguished academician and researcher in the field of engineering and technology. The lecture was started with a welcome note and introduction about Industry 4.0 delivered by Dr S. S. Chauhan, Director, RRIMT, Lucknow

Dr. Upadhyay began the session by explaining the concept and evolution of Industry 4.0, highlighting the transition from traditional manufacturing systems to smart and interconnected industrial ecosystems. He emphasized how emerging technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, Cyber-Physical Systems, Cloud Computing, Robotics, and Automation are reshaping industries across the globe.

Special focus was laid on the role of electrical engineers in the implementation of Industry 4.0 practices. Dr. Upadhyay discussed applications such as predictive maintenance of electrical systems, smart grids, intelligent machines, mechatronics integration, and energy-efficient manufacturing. He also shared real-world case studies and examples where Industry 4.0 has significantly improved productivity, efficiency, and sustainability.

The lecture was highly interactive, with students actively participating in discussions on the future challenges and opportunities in the era of digital transformation. Dr. Upadhyay encouraged students to equip themselves with interdisciplinary knowledge, practical skills, and innovative thinking to stay relevant in the rapidly changing industrial landscape.

The session concluded with a vote of thanks, acknowledging Dr. Upadhyay's valuable insights and motivating words. The lecture proved to be informative, inspiring, and enriching, providing the students with a deeper understanding of Industry 4.0 and its impact on their future careers.



## Expert Lecture on LIFE-LONG LEARNING

The ElectriX Society of the Department of Electrical Engineering organized an insightful Expert Lecture on the theme of "Life Long Learning" on September 26, 2025, from 11:00 AM to 1:00 PM in Seminar Hall-I. Delivered by the esteemed resource person, Mr. Harshendra Singh, the session was designed to instill the critical importance of continuous skill upgradation and self-driven professional development among students and faculty.

The lecture powerfully articulated the core objective of moving beyond formal education to cultivate an enduring passion for knowledge. Mr. Singh emphasized that in a rapidly evolving technological landscape, academic degrees are merely the starting point. He underscored that lifelong learning is the key driver for career growth, enhanced employability, and personal fulfillment.

A compelling highlight of the lecture was the practical demonstration of this philosophy through the contemporary lens of Artificial Intelligence. Mr. Singh presented a detailed case study on "How AI Changes the Renewable Energy Industry," effectively bridging the conceptual talk with a tangible, industry-relevant example. Through a series of engaging presentations, he illustrated how AI is revolutionizing the renewable sector by optimizing energy systems, improving efficiency, reducing costs, and enhancing reliability. This segment vividly showed how continuous learning in cutting-edge fields like AI is directly applicable to solving real-world challenges in vital areas such as sustainable energy.

The lecture successfully achieved its goal of creating awareness and motivating the audience. By linking the abstract concept of lifelong learning to the concrete, transformative impact of AI in renewable energy, Mr. Singh provided a clear roadmap for students.



# Industrial Visit at RAMESHWARDAS RAMNIWAS GROUP OF INDUSTRIES (RN FEEDS)



The Department of Electrical Engineering at R. R. Institute of Modern Technology, Lucknow, organized an industrial visit for third-year students to Rameshwar Das Ram Niwas Group of Industries (RN Feeds) on 30 September 2025. The visit was organized under the supervision of the ElectriX Society of Electrical Engineering with the objective of providing students practical exposure to industrial electrical systems, automation technologies, and energy management practices. This visit helped bridge the gap between theoretical classroom learning and real-world industrial applications.

During the plant tour, students observed the 11 kV/415 V substation, transformers, circuit breakers, and protective relays used to ensure uninterrupted power supply. The automation and control room showcased PLC and SCADA systems controlling various stages of production such as batching, mixing, pelleting, and packaging. Students also learned about the use of sensors, load cells, and variable frequency drives (VFDs) for process optimization. The Motor Control Centers (MCCs) demonstrated different motor starting methods, overload protection, and preventive maintenance techniques.

The visit motivated students to explore careers in industrial automation, power systems, and sustainable energy solutions, successfully fulfilling the academic objectives of experiential learning.



# INDUSTRIAL VISIT AT 400 KV GAS INSULATED SUBSTATION, JEHTA, LUCKNOW

The Department of Electrical Engineering of R. R. Institute of Modern Technology organized an industrial visit for fourth-year students to the 400 KV GIS, Jehta, Lucknow on 18 November 2025 under the supervision of the ElectriX Society of Electrical Engineering. The visit was conducted with the objective of providing students with practical exposure to high-voltage power systems and advanced substation technologies. Students with 100% attendance were eligible and actively participated in this academic activity.



The 400 KV GIS (Gas Insulated Substation), Jehta, is one of the most significant high-voltage substations in the Lucknow region, playing a crucial role in the transmission and reliable distribution of electrical power. The substation uses SF<sub>6</sub> gas-insulated technology, which offers higher reliability, compact design, reduced maintenance, and enhanced safety compared to conventional air-insulated substations.

During the visit, engineers briefed the students on the overall layout and working of the GIS. Students learned about major components such as gas-insulated circuit breakers, disconnectors, earthing switches, current transformers, voltage transformers, bus bars, and protection relays. The functioning of control and relay panels, SCADA-based monitoring, and real-time fault detection systems was also explained in detail.

Overall, the industrial visit to the 400 kV GIS, Jehta was highly educational and enriching. It provided valuable practical insights into modern power transmission infrastructure and strengthened students' technical knowledge. The visit successfully fulfilled its objective of bridging the gap between classroom learning and real-world power system operations, making it a memorable and beneficial experience for all participating students.



# 5-DAYS PRODUCT DEVELOPMENT WORKSHOP

The Department of Electrical Engineering, in association with the ElectriX Society, successfully organized a comprehensive Five-Day Product Development Workshop from November 17 to November 21, 2025. The workshop was specifically designed for the second-year students of the Electrical Engineering Department, aiming to bridge the gap between theoretical academic knowledge and contemporary industrial practices.

Held daily from 9:00 AM to 4:35 PM, the workshop was structured to provide a holistic understanding of real-world product development cycles. The agenda was meticulously planned to transition from conceptual understanding to practical implementation. The first segment focused on identifying the critical gap between industry requirements and academic curriculum, with a particular emphasis on the LED lighting sector. This involved analyzing market demands, comparing syllabus content with industrial expectations, and finalizing practical problem statements rooted in actual industry needs.

The subsequent phase delved into core design practices, contrasting established industry standards with classroom theory. Students engaged in understanding the systematic approach to LED lamp system design used in the industry, examining the differences between theoretical calculations and practical constraints. Key considerations such as component selection based on availability and standards, alongside safety, efficiency, and cost factors, were thoroughly discussed and analyzed.

The culmination of the workshop was the hands-on prototype development module, which provided students with invaluable practical exposure. This segment involved the actual development of a functional LED lamp or bulb prototype. Participants actively engaged in assembly, testing, and troubleshooting processes, encountering and resolving real-world manufacturing and reliability issues. This direct, hands-on experience was instrumental in familiarizing students with industry-oriented testing practices and the end-to-end product development lifecycle.



# NATIONAL SEMINAR ON THE ELECTRIC VEHICLE: ISSUES, INNOVATION, AND FUTURE TRENDS



The Department of Electrical Engineering at R.R. Institute of Modern Technology, Lucknow successfully organized a National Seminar on “Electric Vehicle: Issues, Innovations, and Future Trends” on 27 November 2025. Supported by The Institution of Engineers (India) – Lucknow Chapter, the seminar brought together industry experts, academicians, innovators, startups, and technologists to explore the future of electric mobility in India.

The seminar commenced with an inspiring message highlighting Hon’ble Prime Minister Shri Narendra Modi Ji’s vision for Electric Vehicles and Green Mobility. His commitment toward sustainable development, reduced carbon emissions, and Atmanirbhar Bharat in the EV sector set the tone for the day's technical discussions. The message emphasized India’s rapid progress in clean energy, manufacturing, and EV adoption—encouraging educational institutions to contribute through research and innovation.



## Programme Overview

The event began with registration, followed by the Inaugural Session and Lamp Lighting Ceremony. Dr. S. S. Chauhan, Director, RRIMT, delivered the Welcome Address, highlighting the growing importance of EV technology, renewable energy integration, and the role of engineering institutions in driving green mobility in India. The seminar included eight expert lectures by distinguished speakers from the fields of automotive engineering, defence technology, MSME development, industrial systems, and startup innovation.



## Expert Sessions Summary

### 1. Address on EV Technology – Mr. H. K. Agrawal (IETE)

Mr. Agrawal delivered a technical session on EV system design, power electronics, safety standards, and industrial innovation required for India's EV ecosystem.

### 2. Automotive Manufacturing Insights – Mr. Prabhat Kumar Jha (Ex-DGM, Maruti Suzuki)

He discussed modern manufacturing practices, EV production challenges, quality control, and India's preparedness for large-scale EV deployment.

### 3. MSME Opportunities – Mr. K. P. Singh, President (MSME), New Delhi

He emphasized the role of MSMEs in EV component manufacturing, battery production, and technology adoption, highlighting new opportunities for young entrepreneurs.

Lunch Break.

### 4. Global EV Technologies – Mr. Saurabh Mohan Saxena (AHODS Technologies)

He provided a global perspective on smart EV solutions, emerging technologies, battery management systems, and innovation strategies.

### 5. Defence & Aerospace Perspective – Air Commodore S. S. Saxena, VSM

He shared insights on defence-grade engineering, energy systems, and the potential of aerospace technologies to drive advanced EV research.

### 6. EV Startups & Mobility Solutions – Mr. Akshay (Prestantia Creations, Vani Moto, All Spark Cabs)

He highlighted real-world challenges faced by EV startups, logistics transformation, battery swapping models, and the future of e-mobility in India.

### 7. Academic & Research Vision – Prof. Shailendra Singh Chauhan

Prof. Chauhan addressed the importance of interdisciplinary research, institutional development, innovation culture, and the future of sustainable transportation.

### Vote of Thanks – Mr. K. P. Yadav, HOD (EE)

He expressed gratitude to all speakers, guests, faculty, and students.



### Conclusion

The National Seminar served as an important platform for knowledge exchange on electric mobility. By aligning with the national vision for green transportation, the seminar encouraged young engineers to contribute to India's sustainable and technologically advanced future. The participation of multiple experts across domains ensured an enriching learning experience for all attendees.



# IN-HOUSE INDUSTRIAL TRAINING

The Electrical Department's in-house industrial training initiative this semester has been meticulously designed to address the evolving needs of its student cohorts, providing tailored, hands-on experience crucial for their professional development.

For second-year students, the training focuses on foundational industrial skills, introducing MATLAB for technical computing and simulation alongside core Embedded Systems principles. This bridges the gap between theoretical knowledge and practical application from an early stage.

Third-year students delve deeper into specialized areas, advancing their expertise in Embedded Systems with more complex, project-based learning. Concurrently, fourth-year students are introduced to the frontiers of modern manufacturing through Industry 4.0 concepts, exploring the integration of cyber-physical systems, IoT, and smart automation.

These sessions were expertly conducted by Mr. Mahfooz Ahmad, Mr. Aqib Khan & Mr. Akash Kushwaha who provided comprehensive theoretical foundations and practical skills in key areas including Embedded Systems, PLC, and SCADA. This direct exposure to industry-standard tools and practices significantly enhances student preparedness for industrial environments.

Participating in this training has a transformative effect, equipping students with the practical dexterity required in the ever-evolving field of electrical engineering. By engaging with real-world scenarios, students grasp intricate concepts more profoundly and cultivate essential problem-solving acumen. This exposure not only heightens academic prowess but also boosts employability, creating well-rounded graduates capable of seamlessly integrating theory with practice in the dynamic landscape of modern industries.



## TIRANGA YATRA



On a bright November morning, the campus pathways transformed into a flowing river of national pride. On 25th November 2025, the spirited third-year students of our department swapped their lab coats and notebooks for the glorious Tiranga, participating enthusiastically in the 'Tiranga Yatra'.

The event was more than a march; it was a vibrant, moving tapestry of patriotism and youthful energy. Led by student volunteers, the yatra wound its way through the college vicinity, with chants of "Bharat Mata Ki Jai" and "Vande Mataram" resonating in the air. The sight of hundreds of students, united under the national flag, created a powerful spectacle of collective spirit and constitutional values.

"For us, it wasn't just about carrying the flag," shared Divyanshu, a third-year participant. "It was about feeling the weight and honour of its meaning—the sacrifices it represents and the future we are building. Walking shoulder-to-shoulder with our batchmates in this way filled us with an incredible sense of unity and purpose."

The Tiranga Yatra concluded with a pledge-taking ceremony, where students vowed to uphold the dignity of the nation and contribute to its progress. The event left an indelible mark, proving that the true spirit of India shines brightest in the enthusiasm and unity of its young minds, ready to carry the nation forward with pride and responsibility.



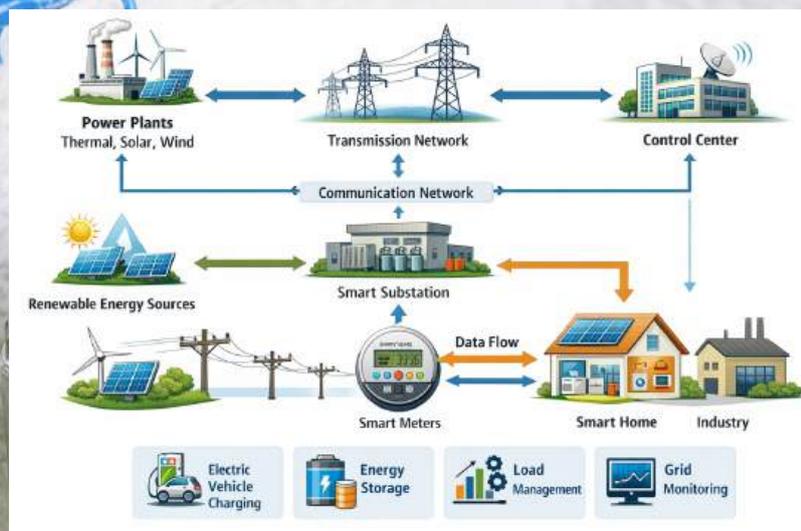
# SMART GRID TECHNOLOGY: THE INTELLIGENT EVOLUTION OF OUR ELECTRICAL LIFELINE

Attruba Fatima ( 2203610200012)

In the arteries of our modern world, where electricity pulses as the lifeblood of civilization, a quiet revolution is reshaping the very architecture of power. The traditional electrical grid—a monumental engineering achievement of the 20th century—stands at a crossroads. Designed for a simpler era of predictable, one-way power flow from centralized fossil fuel plants to passive consumers, this aging infrastructure now strains under the weight of 21st-century demands: explosive urbanization, soaring energy consumption, the urgent integration of variable renewable sources like wind and solar, and the rapid rise of electric vehicles. This strain manifests in concerning symptoms—high transmission losses, sluggish fault response, inefficient energy management, and a lack of real-time visibility into system health. The answer to these multifaceted challenges is not merely an upgrade, but a paradigm shift: the emergence of the Smart Grid, an intelligent, adaptive, and digitally empowered nervous system for our electrical future.

At its core, a Smart Grid transcends the "dumb pipe" model of traditional networks. It is an electrically efficient, digitally enabled ecosystem that weaves together advanced sensing, high-speed communication, and intelligent control technologies into the very fabric of power generation, transmission, and distribution. The most profound change is the establishment of a two-way dialogue. Unlike the monologue from utility to customer, the Smart Grid enables a continuous conversation. Utilities gain real-time, granular visibility into grid conditions, while consumers, equipped with smart meters and connected devices, become active participants. They can receive dynamic pricing signals, automate energy use, and even sell excess power from rooftop solar panels back to the network. This bidirectional flow of both electricity and information enables automated, data-driven decision-making for unparalleled efficiency, reliability, and sustainability.

The imperative for this transformation is driven by undeniable forces. First, managing skyrocketing demand and punishing peak loads requires intelligent load balancing, not just building more power plants. Second, to meet climate goals, the grid must seamlessly absorb distributed and intermittent renewable generation, balancing sunny and windy days with calm, cloudy ones. Third, the grid must combat staggering technical and non-technical losses through precise monitoring.

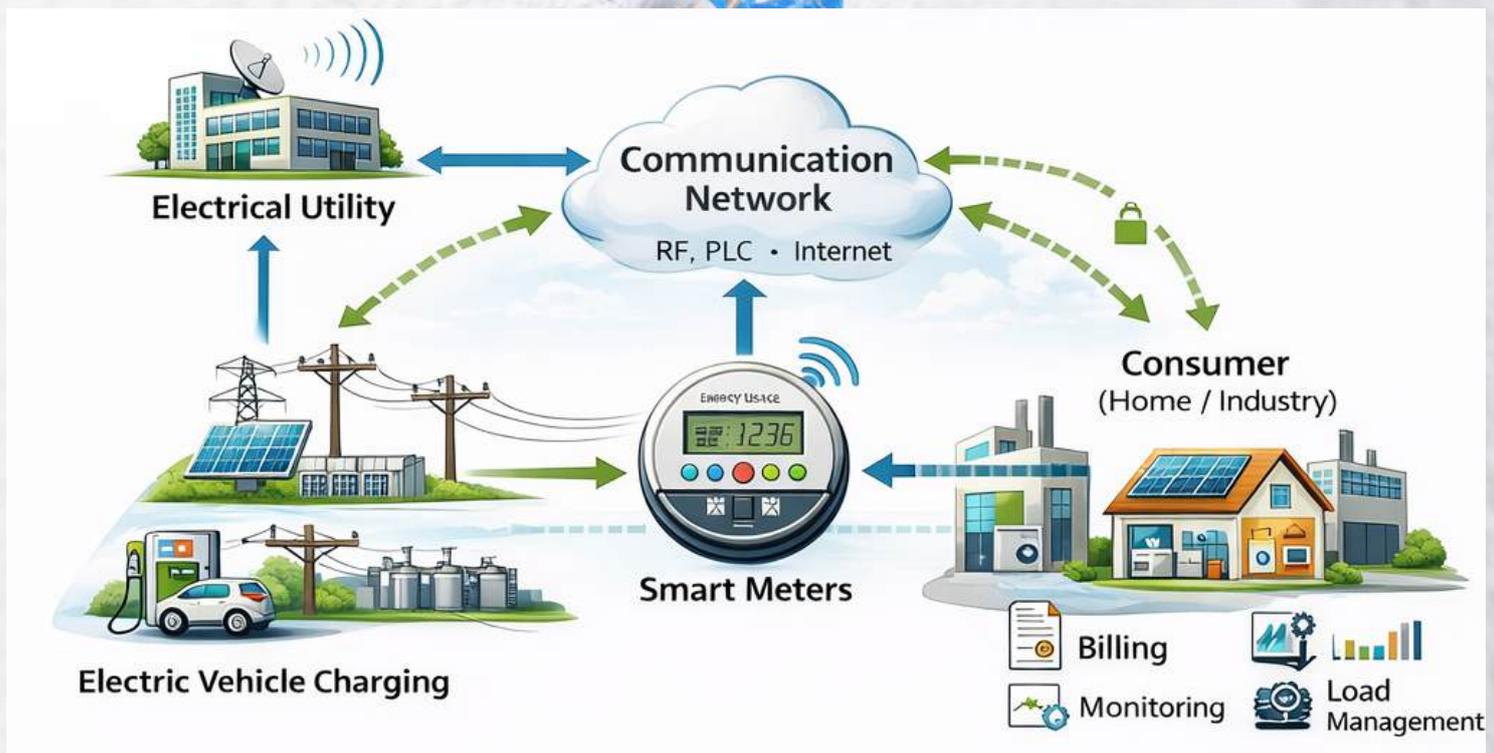


Fourth, it must ensure rock-solid reliability and power quality in an era of increasing digital dependence. Finally, it must provide the intelligent backbone to support the mass adoption of electric vehicles and smart appliances without overloading local circuits. The Smart Grid, visualized in its holistic architecture, integrates smart generation from diverse sources, smart transmission with real-time monitoring, smart distribution with self-healing capabilities, and smart consumers into a cohesive, communicative whole.

The advantages of this intelligent overlay are transformative. Resilience is dramatically enhanced through faster fault detection and "self-healing" capabilities that can isolate problems and reroute power in milliseconds, minimizing outages. Efficiency is optimized, reducing both operational costs and the system's carbon footprint by minimizing losses and better integrating clean energy. Consumers are empowered with control and insight, using demand response programs to lower bills while helping utilities balance the grid. Crucially, the Smart Grid provides the essential platform for integrating electric vehicles, energy storage, and distributed energy resources, turning challenges into grid-strengthening assets.

However, the path to this smart future is not without significant roadblocks. The transition requires massive capital investment to modernize legacy infrastructure. A digitally connected grid presents a larger attack surface, demanding robust, evolving cybersecurity defenses. The granular consumption data collected raises legitimate concerns about consumer privacy and data ownership. Furthermore, deployment requires a new generation of skilled technicians and updated regulatory frameworks that incentivize innovation rather than hinder it.

Despite these challenges, Smart Grid technology represents nothing less than a fundamental paradigm shift in power system engineering. It is the essential convergence of the physical electrical world with the digital realm of information technology. By making the grid observable, controllable, and automated, it ensures the efficient, reliable, and sustainable delivery of electricity for a digital, electrified, and climate-conscious world. It is not merely an upgrade to our infrastructure; it is the intelligent backbone upon which our energy future will be built—powering progress with resilience, insight, and a newfound harmony between human need and planetary health. The Smart Grid is, unequivocally, the future of electrical power systems.



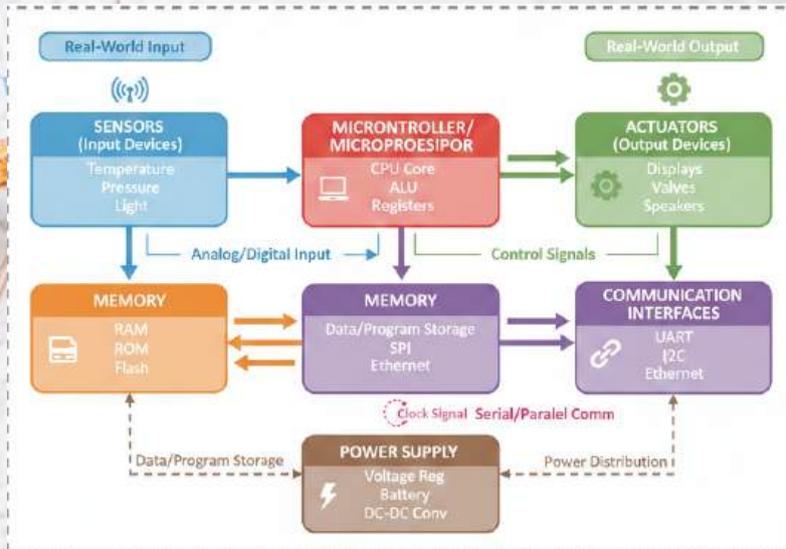
# EMBEDDED SYSTEMS: THE INVISIBLE ORCHESTRA OF MODERN LIFE

VISHAL YADAV ( 2203610200043 )

In the quiet hum of our refrigerators, the precise rhythm of our heart monitors, and the responsive intelligence of our vehicles, an unseen conductor orchestrates the symphony of modern existence. This maestro is the embedded system—a specialized computing unit seamlessly integrated into larger devices, designed to perform dedicated functions with remarkable efficiency. Unlike their versatile cousins, the general-purpose computers, embedded systems are the unsung heroes of specificity, quietly powering the devices that have become extensions of our very being. From the moment we wake to a smart alarm that analyzes our sleep cycles, to the automated home security that watches over us as we rest, these miniature technological marvels have woven themselves into the fabric of our daily lives, transforming routine into ritual, necessity into convenience, and function into intelligent interaction.

At its core, an embedded system follows an elegant architectural blueprint. The heart of this system is the microcontroller or microprocessor—a compact, purpose-built brain that executes pre-programmed instructions. This central unit communicates with an array of sensors, the system's eyes and ears, which gather real-world data such as temperature, pressure, motion, or light. Once processed, decisions are translated into action through actuators—motors, valves, displays, or speakers—that physically interact with the environment. Supporting this operation are memory modules for data and instruction storage and communication interfaces that enable dialogue with other devices or networks. This integrated, task-specific design, often visualized in a block

diagram, is the foundation of their reliability and ubiquity, allowing them to operate with minimal power and maximum focus.



The omnipresence of embedded systems is a testament to their transformative power. In our homes, they have elevated appliances from mechanical tools to intelligent partners. A modern washing machine is no longer a simple timer and drum; its embedded system calculates load weight, fabric type, and soil level to optimize water, energy, and detergent use. In healthcare, they are often literal lifelines. Portable glucose monitors and insulin pumps form closed-loop systems that autonomously manage diabetes, while advanced imaging machines like MRIs rely on multiple embedded computers to control powerful magnets, process complex data, and generate diagnostic images with life-saving precision. The automotive realm presents perhaps the most concentrated ecosystem, with a single vehicle containing over a hundred embedded Electronic Control Units (ECUs). These systems manage everything from fuel injection efficiency and anti-lock braking to adaptive cruise control and lane-keeping assist, making split-second decisions that enhance both performance and safety.

## Applications of Embedded Systems in Everyday Life

### Home Appliances

- Smart Thermostat**  
Learns schedule  
Optimizes energy
- Washing Machine**  
Auto-load sensing  
Water optimization
- Microwave Oven**  
Sensor cooking  
Precise timing
- Refrigerator**  
Temp management  
Inventory tracking
- Robot Vacuum**  
Navigation  
Obstacle avoidance

### Medical Equipment

- Pacemaker**  
Heart rhythm regulation
- Insulin Pump**  
Continuous glucose monitoring
- ECG Monitor**  
Real-time cardiac data analysis
- MRI Scanner**  
Precise magnet control  
Image processing
- Venitator**  
Breath control  
Pressure monitoring

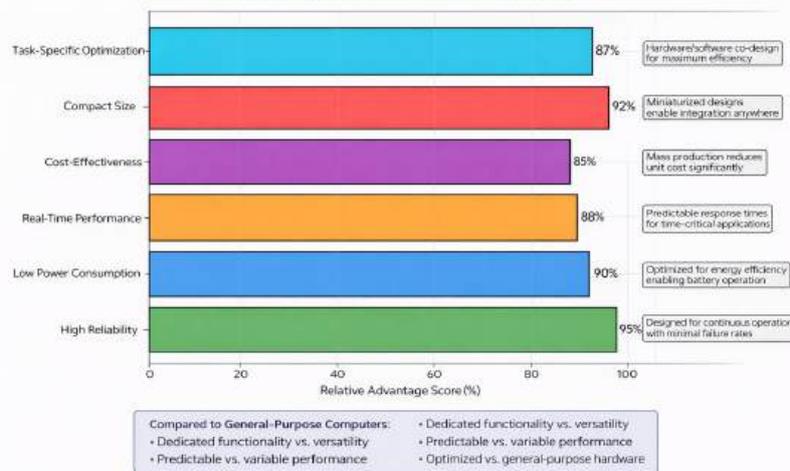
### Automotive Systems

- Engine Control**  
Fuel injection  
Emission control
- ABS Brakes**  
Wheel slip detection  
Pulse braking
- Airbag System**  
Crash detection  
Millisecond response
- Venitator**  
Touch interface  
Navigation
- ADAS**  
Lane keeping  
Collision avoidance

As we stand on the brink of an even more connected future, the role of embedded systems is set to deepen. They are the fundamental building blocks of the IoT, the enablers of smart cities, and the backbone of industrial automation. By continuing to shrink in size while expanding in capability, these invisible engines will further blur the line between the digital and physical worlds, creating an environment that is not only connected but intuitively responsive to human needs. Their story is one of quiet revolution—a testament to how specialized, focused intelligence, working diligently in the background, can power a visible and vibrant future for all.

The ascendancy of embedded systems is driven by compelling advantages that align perfectly with the demands of modern technology. Their high reliability ensures consistent operation for years, decades, under demanding conditions—a non-negotiable requirement in medical or automotive safety. Low power consumption allows devices like wireless sensors and smartwatches to run for extended periods on small batteries, enabling the proliferation of the Internet of Things (IoT). Most critically, many possess real-time performance, guaranteeing responses within strict, predictable timeframes, which is essential when controlling airbag deployment or stabilizing a drone mid-flight.

Key Advantages of Embedded Systems



# ENERGY STORAGE SYSTEMS: POWERING THE BRIDGE TO A SUSTAINABLE FUTURE

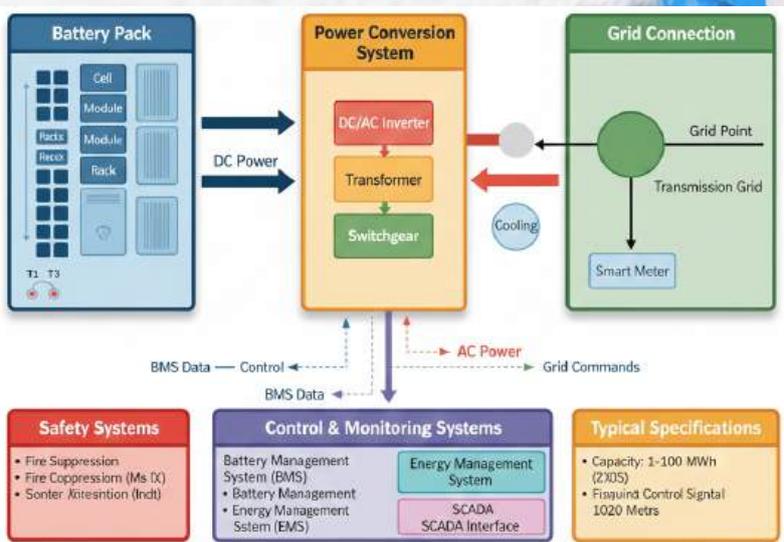
SACHIN YADAV ( 2403610209015 )

As the world accelerates toward a future powered by renewable energy, we face a fundamental challenge: the sun doesn't always shine, and the wind doesn't always blow. This inherent intermittency of our cleanest power sources threatens to stall the energy transition unless we can capture electricity when it's abundant and release it precisely when needed. Enter energy storage systems—the indispensable bridge between today's fossil-dependent grid and tomorrow's sustainable energy ecosystem. Far more than simple batteries, these sophisticated systems are the intelligent shock absorbers of our electrical networks, balancing supply and demand with unprecedented precision. From stabilizing national power grids to extending the range of electric vehicles, energy storage represents the missing link in our clean energy puzzle, transforming renewable resources from unreliable alternatives into dependable primary power sources and enabling a future where clean, resilient energy is available on demand, day or night.

The current champion, lithium-ion batteries, dominates markets from smartphones to electric vehicles and grid-scale installations, thanks to their high energy density and rapidly declining costs. However, concerns about safety, raw material sourcing, and performance degradation are driving innovation toward next-generation solutions. Solid-state batteries, which replace flammable liquid electrolytes with solid ceramic or polymer materials, promise a quantum leap in safety and energy density, potentially doubling electric vehicle ranges while dramatically reducing fire risks. Meanwhile, flow batteries employ a different architecture entirely, storing energy in liquid electrolytes contained in external tanks, making them exceptionally well-suited for long-duration grid storage. Each technology occupies a unique niche in the energy landscape, with no single solution meeting all needs, creating a diverse ecosystem where different storage types work in concert to address varying requirements for power, duration, and cost.

A modern Battery Energy Storage System (BESS), as depicted in detailed schematics, represents a sophisticated integration of multiple subsystems working in perfect harmony. At its core are thousands of individual battery cells arranged in modules and racks, managed by an intelligent Battery Management System (BMS) that monitors cell health, temperature, and state of charge to ensure safety and longevity.

This DC power is converted to grid-compatible AC through a Power Conversion System (PCS)—essentially a bidirectional inverter that serves as the system's translator. Surrounding this hardware is advanced control software that makes real-time decisions about charging and discharging based on market signals, grid conditions, or renewable generation forecasts.

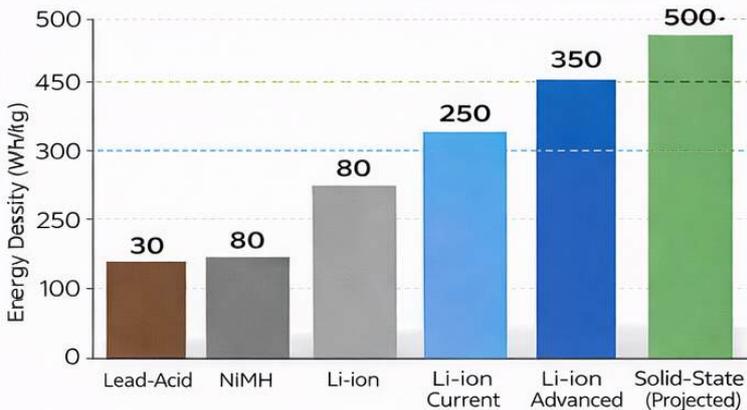


The evolution of energy storage is a story of remarkable technological diversity, with different chemistries optimized for specific applications.

The entire system is housed in secure, climate-controlled enclosures, often with integrated fire suppression and thermal management systems, creating a self-contained power plant that can be deployed almost anywhere, from urban substations to remote microgrids.

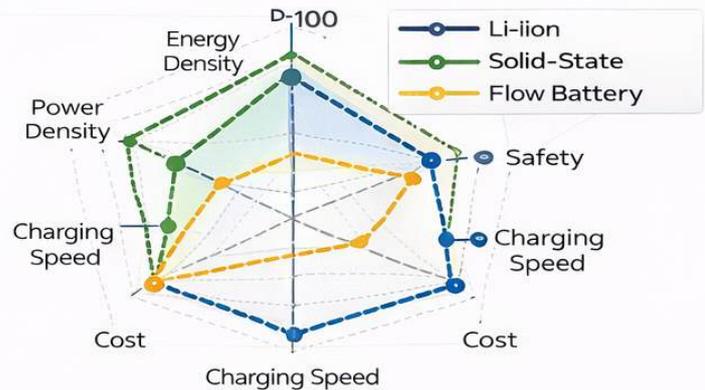
Despite rapid progress, significant challenges remain on the path to widespread adoption. The upfront capital costs, though falling, still present barriers for many projects. Raw material supply chains for lithium, cobalt, and other critical minerals face geopolitical and environmental concerns that demand circular economy solutions. Performance limitations persist, particularly regarding energy density, charging speed, and cycle life. Safety incidents, while rare, highlight the need for continued improvements in thermal management and fault protection. Furthermore, regulatory frameworks and market structures designed for traditional one-way power flows must evolve to properly value the multiple services that storage provides, creating revenue streams that support further investment and innovation.

**A. Energy Density Comparison**



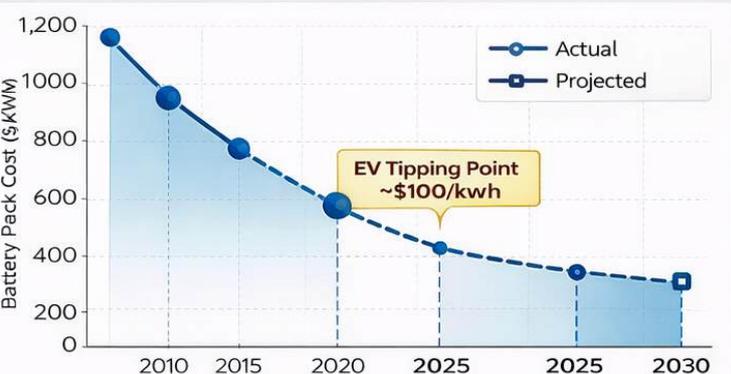
The advantages of advanced energy storage systems are transforming our approach to energy management. They provide critical grid services like frequency regulation and voltage support, traditionally supplied by fossil fuel plants. By shifting consumption to off-peak hours, they reduce strain on aging infrastructure and defer costly upgrades. For renewable integration, they smooth the output of wind and solar farms, making these variable resources behave more like conventional power plants. Perhaps most compellingly, they enhance energy resilience, providing backup power during outages and enabling communities to maintain essential services when the main grid fails. These benefits extend beyond utilities to consumers, who can use home storage systems to maximize self-consumption of rooftop solar, participate in demand response programs, and achieve greater energy independence.

**C. Technology Comparison Radar**



The future of energy storage shines brightly, guided by clear technological trajectories. Research focuses on higher energy density through silicon anodes, lithium-sulfur chemistries, and solid-state designs that promise smaller, lighter, more powerful batteries. Faster charging technologies aim to make refueling electric vehicles as quick as filling a gas tank, requiring breakthroughs in battery architecture, thermal management, and charging infrastructure. Longer lifecycles are being pursued through self-healing materials and advanced electrolytes that can withstand thousands of deep charge-discharge cycles with minimal degradation. Beyond batteries, complementary technologies like compressed air, flywheels, and thermal storage are advancing, creating a diverse portfolio that addresses different durations and scales.

**B. Cost Reduction Trends**



# POWER ELECTRONICS: THE INTELLIGENT BRIDGE TO A RENEWABLE ENERGY FUTURE

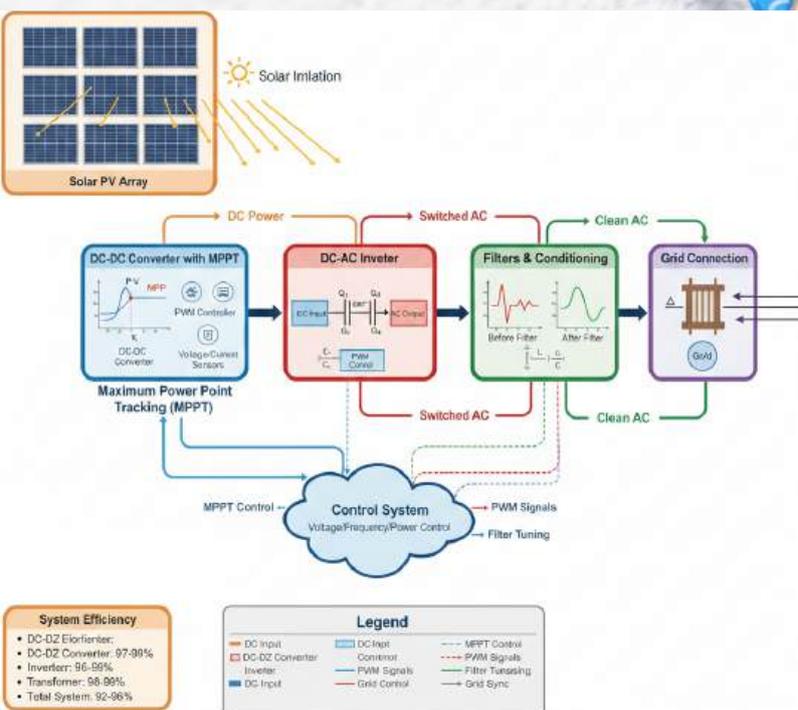
MIZAN MIYAN ( 2203610200022)

As the world rushes to harness the boundless power of nature—capturing photons from the sun, kinetic energy from the wind, and the flow of water—we encounter a fundamental mismatch: the clean, variable electricity produced by renewables exists in forms fundamentally incompatible with our century-old electrical grid. This incompatibility forms the critical bottleneck in the energy transition, a bottleneck that can only be cleared by the sophisticated, silent maestro of the modern power system: power electronics. Far more than simple converters, power electronics systems are the intelligent, high-speed translators and optimizers that transform raw, chaotic natural energy into the pristine, grid-compatible power that lights our cities and powers our industries. Without this transformative technology, the promise of solar, wind, and other renewable sources would remain trapped at their source, unable to traverse the complex journey from generation to consumption, making power electronics not merely a supporting technology but the indispensable bridge between our sustainable aspirations and electrical reality.

At its core, power electronics addresses the fundamental mismatch between how renewables generate power and how the grid demands it. Solar panels produce direct current (DC) at voltages that fluctuate with every passing cloud, while wind turbines generate alternating current (AC) with frequencies that vary with wind speed. Our electrical grid, however, requires rock-steady, synchronized AC at precisely 50 or 60 Hz. This translation from nature's variability to grid rigidity is achieved through sophisticated power electronic interfaces. In a solar photovoltaic system, for instance, the journey begins with DC-DC converters that optimize the panel's operating point through Maximum Power Point Tracking (MPPT), followed by inverters that perform the crucial alchemy of converting DC to perfectly synchronized AC. This entire conversion chain, managed by high-speed semiconductor switches, ensures that every watt of captured sunlight meets the grid's exacting standards.

The role of power electronics extends far beyond basic conversion, encompassing three critical functions that ensure stable, efficient integration. First, voltage and frequency control maintains the delicate balance of the grid, using advanced algorithms to synthesize perfect sine waves that match the grid's exact parameters. Second, power quality improvement actively filters harmonics and compensates for voltage fluctuations, providing reactive power support traditionally supplied by fossil fuel plants. Third, maximum power extraction continuously hunts for the optimal operating point of solar panels or wind turbines, ensuring they deliver their highest possible yield regardless of environmental conditions. Together, these functions transform renewable generators from passive sources into active, grid-supportive participants.

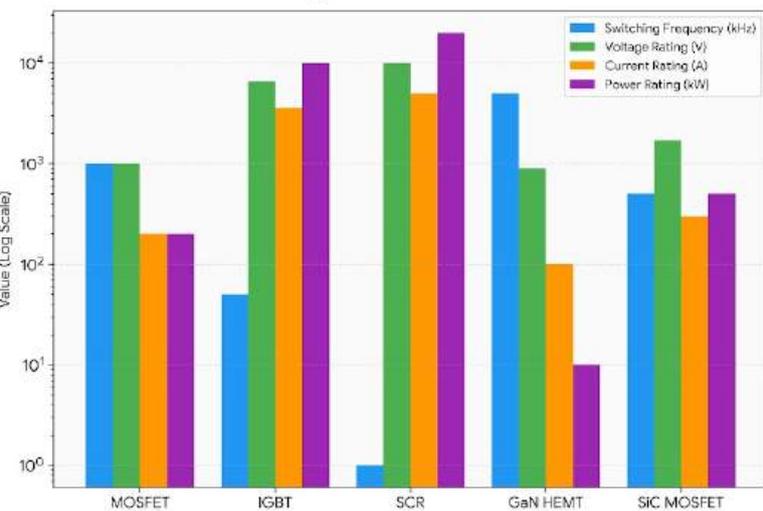
These intelligent functions are executed by robust semiconductor devices that form the workhorses of power conversion. The MOSFET (Metal - Oxide -



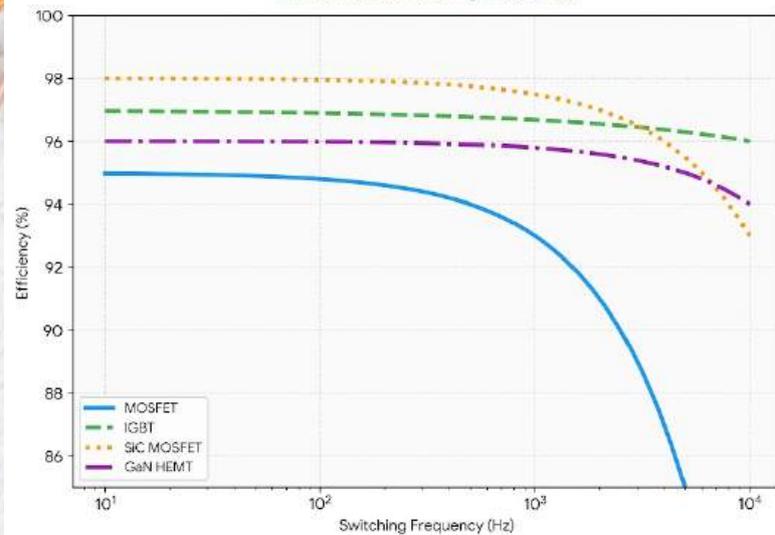
Semiconductor Field-Effect Transistor) serves as the sprinter, excelling at ultra-high-frequency switching for lower-power applications. The IGBT (Insulated-Gate Bipolar Transistor) acts as the marathoner with strength, balancing control and current-handling capability to become the dominant device in medium to high-power renewable systems. The SCR (Silicon-Controlled Rectifier), while increasingly supplemented by more controllable devices, remains relevant for very high-power applications. These components, arranged in sophisticated topologies within inverters and converters, perform the high-speed switching—thousands of times per second—that makes precise power control possible.

be carefully filtered to prevent disruptions. Reliability under harsh environmental conditions—from desert heat to coastal salinity—requires robust packaging and protection. Cybersecurity of increasingly digital controls presents new vulnerabilities. And the quest for higher efficiency drives relentless innovation in wide-bandgap semiconductors like silicon carbide and gallium nitride, promising revolutionary improvements in performance and miniaturization.

Key Device Characteristics



Efficiency vs Switching Frequency



The inverter-based renewable energy system represents the culmination of power electronics integration. Modern systems employ modular, multi-level inverter architectures that provide superior efficiency, voltage handling, and fault tolerance. These systems don't merely convert power; they actively communicate with the grid, responding to disturbances in milliseconds to maintain stability. They enable features like low-voltage ride-through, allowing renewable plants to remain connected during grid faults—a capability once exclusive to conventional generators. Furthermore, advanced grid-forming inverters can actually create and stabilize microgrids, providing black-start capability and operating independently when the main grid fails.

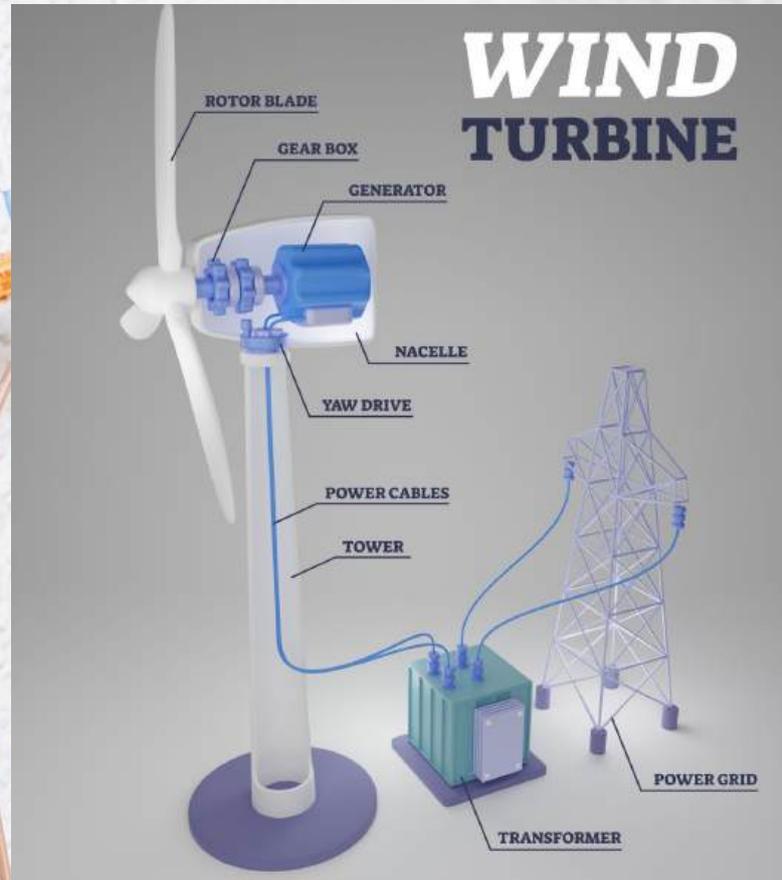
Ultimately, power electronics represents the essential nervous system of the renewable energy revolution. As we move toward grids dominated by variable resources, the intelligence embedded in these systems will determine not just how much clean energy we can generate, but how reliably and efficiently we can use it. They enable the transition from centralized, one-way power flows to distributed, bidirectional energy networks where every home and business can become both consumer and producer. By ensuring efficient, stable, and intelligent operation, power electronics doesn't just support the integration of renewables—it actively enables the grid to absorb ever-higher levels of clean energy, making them the critical enablers of a sustainable, resilient, and intelligent energy future.

The challenges facing power electronics are as significant as their contributions. Switching losses generate heat that demands sophisticated thermal management. Electromagnetic interference must

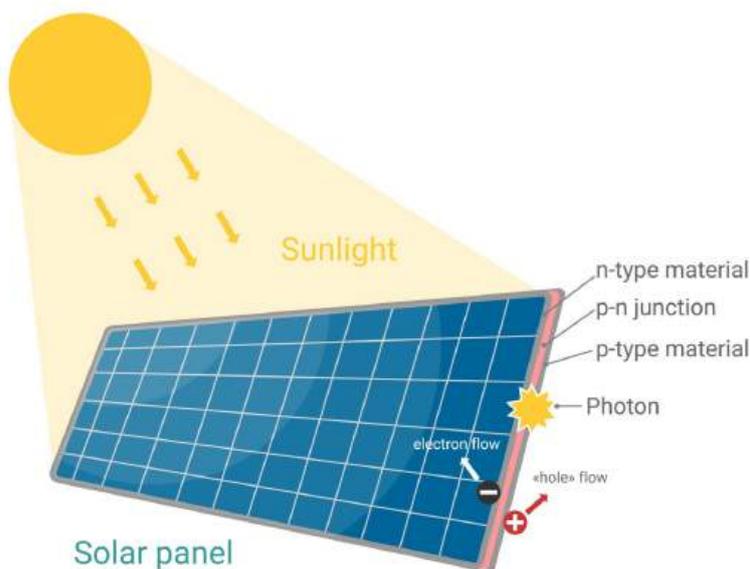
# RENEWABLE ENERGY TECHNOLOGIES: THE CORNERSTONE OF A SUSTAINABLE FUTURE

PRINCE JAISWAL ( 2403610200041)

In an era defined by unprecedented technological advancement and global interconnectedness, humanity faces a profound paradox: our very progress threatens the planetary systems that sustain us. The engine of modern civilization—energy—has been powered predominantly by fossil fuels for over a century, driving industrialization and economic growth while simultaneously casting a shadow of environmental degradation. This reliance on finite resources has triggered a triple crisis: accelerating climate change fueled by greenhouse gas emissions, pervasive air and water pollution affecting millions, and the geopolitical instability born of resource scarcity. As global energy demand surges alongside population growth and economic development, we stand at a critical inflection point where our energy choices will determine the habitability of our planet for generations to come. Renewable energy technologies emerge not merely as an alternative but as the essential foundation for sustainable development—a comprehensive solution that harmonizes economic progress, environmental stewardship, and social equity, offering a pathway to decouple human advancement from ecological destruction.



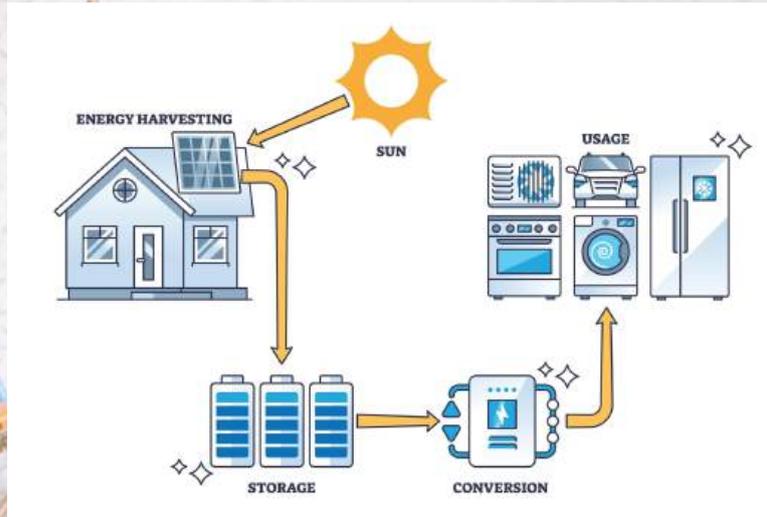
The renewable energy landscape presents a diverse portfolio of technologies, each harnessing nature's abundant and perpetual forces in unique ways. Solar energy captures the sun's radiance through photovoltaic cells that convert light directly into electricity or through solar thermal systems that concentrate heat for power generation and industrial applications. Wind energy transforms kinetic air movement into electrical power via increasingly sophisticated turbines, with offshore installations tapping into stronger, more consistent coastal winds. Hydropower, the most mature renewable technology, utilizes water's gravitational potential, ranging from massive dam projects to micro-hydro installations that empower remote communities. Biomass energy closes the carbon cycle by converting organic waste into power, heat, and fuels through processes like anaerobic digestion and gasification. Together, these technologies form an integrated ecosystem of energy solutions, each with distinct geographical and application advantages, collectively capable of meeting humanity's energy needs without depleting the planet's resources.



The relationship between renewable energy and sustainable development is symbiotic and multidimensional, touching upon all three pillars of sustainability. Environmentally, renewable technologies offer the most direct pathway to dramatically reducing greenhouse gas emissions, with solar and wind systems producing electricity with near-zero operational emissions. They conserve precious freshwater resources—unlike thermal power plants that consume vast quantities for cooling—and eliminate the particulate pollution that plagues urban centers worldwide. Economically, the renewable sector has become a powerful engine for job creation, generating employment opportunities that span manufacturing, installation, maintenance, and research—often in regions previously dependent on extractive industries. The democratization of energy production through distributed systems fosters energy independence, reducing national vulnerability to volatile global fuel markets while stimulating local economies through investment and innovation.

Perhaps most transformatively, renewable energy advances social equity and inclusive development. By providing decentralized energy access, renewable technologies bypass the need for extensive grid infrastructure, bringing electricity to remote and underserved communities that have historically been left in darkness. This rural electrification unlocks educational opportunities through lighting and internet access, improves healthcare through reliable refrigeration and medical equipment, and empowers women by reducing time spent gathering traditional fuels. Furthermore, renewable energy systems embody the intergenerational equity principle central to sustainability, ensuring that our energy choices today do not compromise the options available to future generations. They represent a shift from exploitative resource extraction to regenerative systems that work in harmony with natural cycles, fostering resilience against climate impacts while building more self-reliant communities.

The integration of renewable energy into modern power systems represents one of the most significant engineering challenges of our time, necessitating a fundamental reimagining of grid architecture and operation. The inherent intermittency of solar and wind resources—their



dependence on weather and diurnal cycles—requires sophisticated solutions for balancing supply and demand. Advanced forecasting systems leverage artificial intelligence and meteorological data to predict renewable output with increasing accuracy. Power electronics serve as the critical interface, converting variable renewable generation into grid-compatible electricity while providing essential stability services like voltage and frequency regulation. Energy storage technologies, from utility-scale batteries to pumped hydro, act as temporal buffers, storing excess generation for use during periods of low production. Together with demand response programs and smart grid technologies, these innovations transform renewable energy from variable resources into reliable pillars of a modern, resilient power system.

Looking forward, renewable energy technologies stand at the threshold of unprecedented scale and sophistication. Continued cost reductions through technological learning and economies of scale are making renewables the most economical choice for new power generation in most of the world. Innovations in floating offshore wind, perovskite solar cells, enhanced geothermal systems, and advanced bioenergy promise to expand the renewable portfolio further. Digitalization through IoT sensors, blockchain-enabled peer-to-peer energy trading, and AI-optimized grid management will enhance efficiency and resilience.

## ELECTRIC VEHICLES: THE TECHNOLOGICAL VANGUARD OF SUSTAINABLE MOBILITY

**KASIM AHMAD ( 2403610200032)**

In the grand narrative of human progress, transportation has long been both an engine of economic growth and a source of environmental burden. For over a century, the internal combustion engine has defined personal mobility, delivering unprecedented freedom while exacting a heavy toll: atmospheric pollution, greenhouse gas emissions, and an unsustainable dependency on finite fossil fuels. Today, at the intersection of climate urgency and technological innovation, electric vehicles (EVs) emerge as the most viable and transformative alternative—a sophisticated fusion of electrical engineering, materials science, and digital intelligence that promises to redefine our relationship with transportation. By replacing explosive combustion with electromagnetic conversion, EVs represent not merely an incremental improvement but a fundamental paradigm shift toward cleaner, smarter, and more sustainable mobility. As cities choke on smog and climate targets grow increasingly urgent, these silent revolutionaries offer a pathway to decarbonize transportation while enhancing performance, connectivity, and user experience.

At their core, electric vehicles operate on an elegantly simple yet technologically sophisticated principle: the conversion of stored electrical energy into mechanical motion. The journey begins with high-capacity battery packs—most commonly lithium-ion cells arranged in complex configurations—that store electrical energy with remarkable density. This stored direct current (DC) power is managed and converted by sophisticated power electronics controllers, which serve as the vehicle's nervous system, precisely regulating energy flow. The controller directs power to the electric motor, where electromagnetic forces create rotational torque, directly propelling the wheels through a single-speed transmission. This direct energy pathway achieves extraordinary efficiency, converting over 77% of electrical energy to motion at the wheels, compared to the 12-30% efficiency of internal combustion engines. Furthermore, regenerative

braking systems capture kinetic energy during deceleration, feeding it back into the battery and extending range—a capability entirely absent in conventional vehicles.

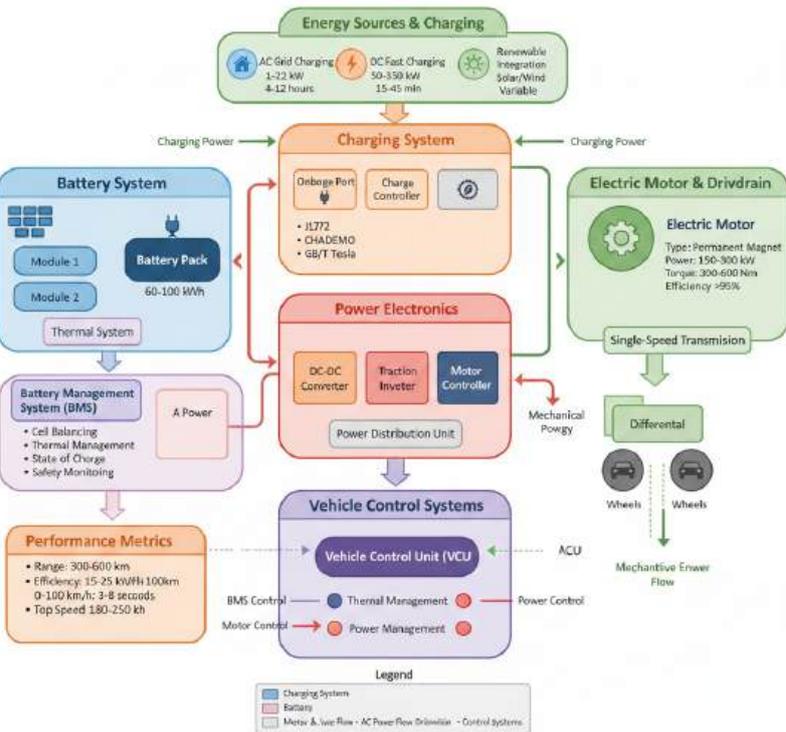
The technological sophistication of modern EVs lies in their integrated systems architecture, comprising four critical components working in perfect harmony. The battery pack, typically consisting of thousands of individual cells with advanced thermal management and battery management systems (BMS), serves as the vehicle's energy reservoir, with capacity measured in kilowatt-hours directly determining range. The power electronics controller, including the inverter that converts DC to AC for the motor, orchestrates power delivery with millisecond precision, managing torque, speed, and regenerative braking. The electric traction motor, often a high-efficiency AC induction or permanent magnet synchronous design, delivers instant maximum torque from standstill, providing the characteristic smooth, silent acceleration that defines the EV driving experience. Finally, the charging system—comprising the charge port, onboard charger, and communication protocols—enables energy replenishment from diverse sources, from standard household outlets to high-power DC fast chargers. Together, these components form a seamlessly integrated propulsion system that is both simpler and more sophisticated than its mechanical predecessor.

The advantages of electric propulsion extend far beyond environmental benefits, creating a compelling value proposition across multiple dimensions. Environmentally, EVs produce zero tailpipe emissions, dramatically improving urban air quality by eliminating pollutants like nitrogen oxides and particulate matter that plague congested cities. Their high efficiency translates directly to lower energy consumption per kilometer traveled, making better use of available energy regardless of its source. Economically, EVs offer significantly lower operating costs, with electricity typically costing 30-50% less than gasoline per

kilometer, and reduced maintenance requirements—no oil changes, spark plugs, or complex transmissions mean fewer service visits and lower lifetime costs. Socially, EVs contribute to reduced noise pollution, creating quieter urban environments that enhance quality of life and public health. These advantages multiply when EVs are powered by renewable energy, creating a truly sustainable transportation ecosystem.

requiring substantial upgrades to distribution networks to handle concentrated charging loads, particularly in residential areas with high EV penetration.

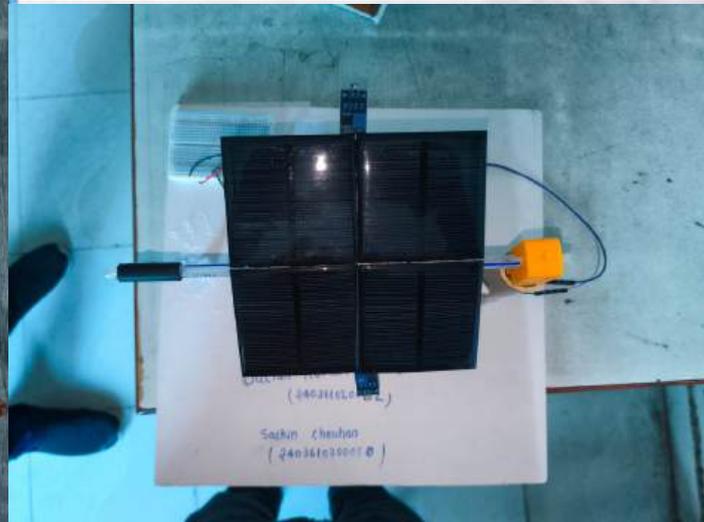
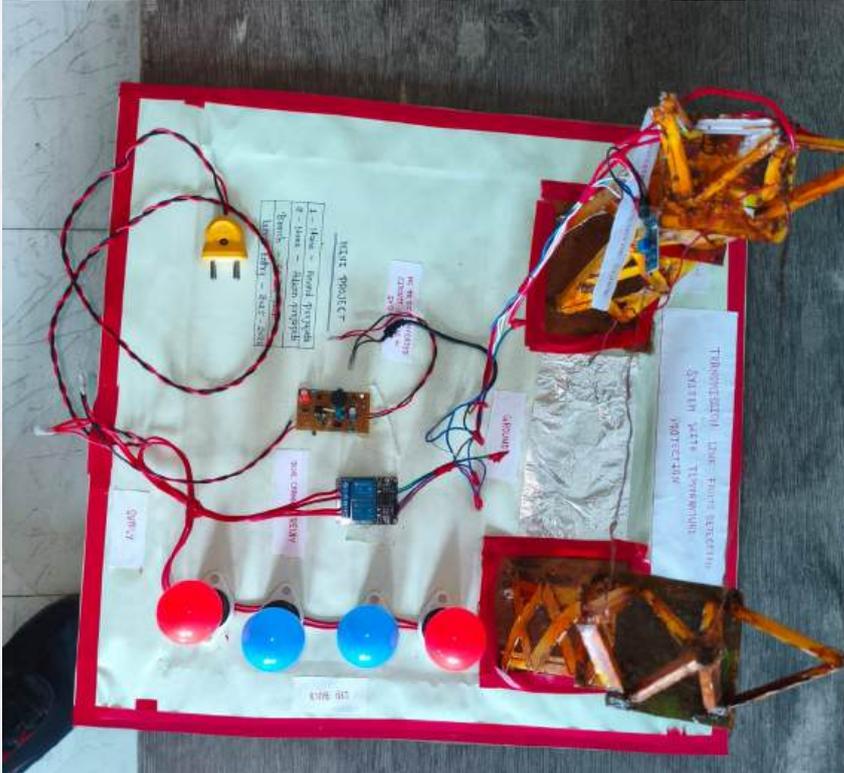
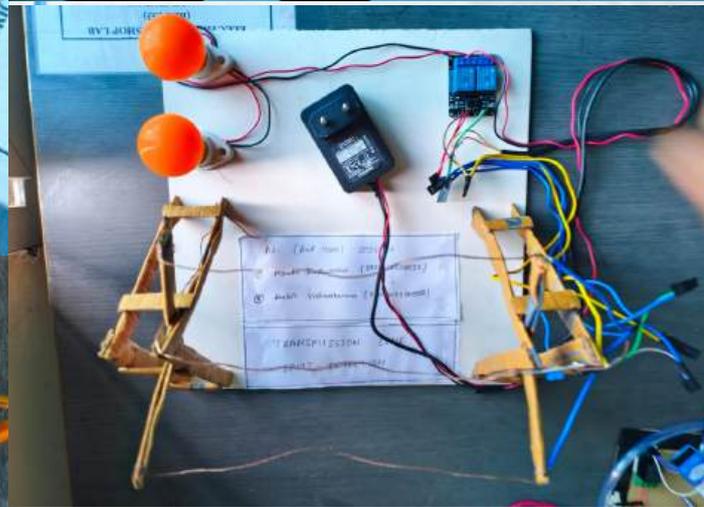
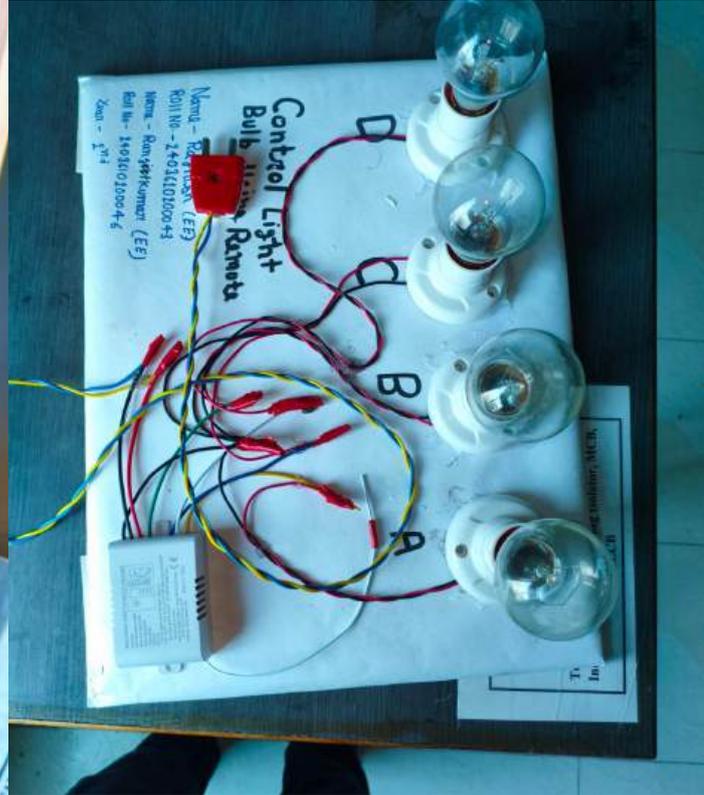
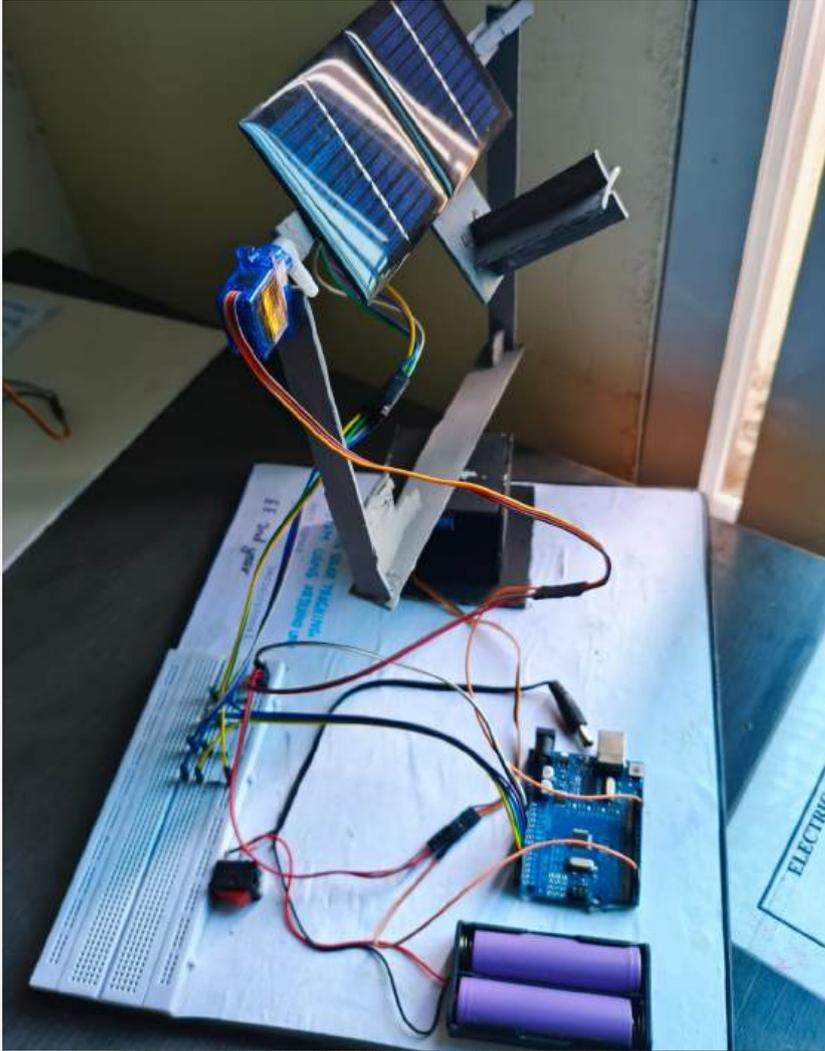
The future scope for electric vehicles is expansive and rapidly evolving, driven by parallel innovations in multiple technological domains. Battery technology advancements promise revolutionary improvements: solid-state batteries offer higher energy density and enhanced safety, potentially doubling range while reducing charging times; lithium-sulfur and silicon-anode chemistries push energy density boundaries; and advanced thermal management extends battery life. Charging infrastructure evolution is accelerating, with ultra-fast charging standards targeting 300+ kilometer range replenishment in under 10 minutes, wireless charging developments enabling convenient "refueling," and smart charging systems that optimize grid integration. Vehicle-to-grid (V2G) technology transforms EVs from energy consumers to grid assets, allowing bidirectional power flow that can stabilize grids, store renewable energy, and create revenue streams for owners. Autonomous driving integration synergizes with electrification, with EVs' simplified drivetrains and abundant electrical power creating ideal platforms for advanced sensor suites and computing systems.



Despite rapid progress, significant challenges impede widespread EV adoption, creating complex hurdles that demand innovative solutions. The limited charging infrastructure remains a critical barrier, with public charging networks still developing unevenly across regions and countries, creating "range anxiety" for potential buyers. Battery technology constraints present multiple challenges: high upfront costs despite declining prices, concerns about lifespan and degradation, dependence on critical minerals like lithium and cobalt with complex supply chains, and limited energy density compared to liquid fuels. Charging time disparities create practical inconveniences, with even DC fast charging requiring 20-45 minutes for meaningful range replenishment versus 5-minute gasoline refueling. Additionally, grid capacity concerns emerge as EV adoption scales,

Policy frameworks and market dynamics are converging to accelerate the EV transition at unprecedented scale. Government incentives and mandates—from purchase subsidies and tax credits to zero-emission vehicle requirements and combustion engine phase-outs—are reshaping automotive markets worldwide. Corporate commitments by major automakers, with hundreds of billions invested in electrification, signal an irreversible industry transformation. Urban planning initiatives are creating EV-friendly environments through dedicated parking, charging infrastructure mandates for new buildings, and low-emission zones that favor electric propulsion.

# BEST MINI PROJECT'S



# OUR TOPPERS IN 2024-2025

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YADAV  
2303610200014**

## 2nd YEAR



**ANIKET SINGH  
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## 3rd YEAR



**AMAN YADAV  
2203610200006**

## 4th YEAR



**SHIVANI YADAV  
2203610209022**

# HIGHEST ATTENDANCE RECORD

S.No.	Roll No	Students Name	Attendance(%)
1	2503610200017	ARPIT RAJ SINGH	100.00
2	2503610200023	JAISH YADAV	100.00
3	2503610200045	SHIVAM YADAV	100.00
4	2503610200005	AKHILENDRA PRATAP SINGH	99.01
5	2503610200007	AMAN YADAV	98.02
6	2503610200015	ANUBHAV KUMAR SINGH	98.02
7	2503610200025	MADHUKAR	98.02
8	2403610200053	SACHIN MADDHESIYA	98.00
9	2503610200029	MUNNA KUMAR SINGH	97.03
10	2403610200043	RAJNISH	97.00
11	2403610200057	SHIVAM	97.00
12	2403610200066	VIKAS KUMAR	97.00
13	2503610200006	AMAN VERMA	96.04
14	2503610200012	ANKIT YADAV	96.04
15	2503610200038	RISHABH	96.04
16	2503610200047	SUMIT YADAV	96.04
17	2403610200049	RISHABH PANDEY (U)	96.00
18	2403610200059	SUDHANSHU	96.00
19	2503610200035	PRINCE YADAV	95.05
20	2503610200049	VISHAL KUMAR YADAV	95.05
21	2203610200019	MANISH GAUTAM	95.00
22	2303610209026	VIKASH MAURYA	95.00
23	2403610200009	ANKITA SINGH	95.00

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## **LIBRARY MANAGEMENT COMMITTEE**

**Secretary**

**Nitesh Kumar**

**B.Tech 3<sup>RD</sup> Yr**

**Member**

**Kasim Ahmad**

**B.Tech 2<sup>ND</sup> Yr**

**विद्या ददाति विनयं, विनयाद्याति पात्रताम्।  
पात्रत्वाद्भानमाप्नोति धानाद्धर्मं ततः सुखम्॥**

**अनुवादः**

विद्या विनय का उपहार देती है, विनय पात्रता को प्राप्त कराती है।  
पात्रता से धार्मिकता प्राप्त होती है, और धार्मिकता से सुख प्राप्त होता है।

**नास्ति विद्यासमो बन्धुर्नास्ति विद्यासमः सुहृत्।  
नास्ति विद्यासमं वित्तं नास्ति विद्यासमं सुखम्॥**

**अनुवादः**

किसी के लिए विद्या के समान बन्धु नहीं होता, किसी के लिए विद्या के  
समान सुहृद् नहीं होता।  
धन के समान विद्या नहीं होती, सुख के समान विद्या नहीं होती॥

**आयुः कर्म च विद्या च वित्तं निधनमेव च।  
पञ्चैतानि विलिख्यन्ते गर्भस्थस्यैव देहिनः॥**

**अनुवादः**

जीवन, कर्म, विद्या, धन और मृत्यु, ये पांच वस्तुएँ गर्भस्थ बच्चे के द्वारा ही  
निश्चित की जाती हैं॥

**विद्याभ्यास स्तपो ज्ञानमिन्द्रियाणां च संयमः।  
अहिंसा गुरुसेवा च निःश्रेयसकरं परम्॥**

**अनुवादः**

विद्याभ्यास, तपस्या, ज्ञान और इंद्रियों के संयम के माध्यम से विद्या प्राप्त  
की जा सकती है।  
अहिंसा और गुरु की सेवा ही सर्वोत्तम कार्य है॥



**ELECTRIX**



# **ELECTRICAL ENGINEERING**

**R.R. Institute of Modern Technology**

**NH-24, Bakshi Ka Talab, Sitapur Road,  
Lucknow, Uttar Pradesh - 226201**

