

# THE CAPITAL CURRENTS



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DEPARTMENT OF ELECTRICAL ENGINEERING  
CAPITAL ENGINEERING COLLEGE  
BHUBANESWAR, ODISHA

HALF-YEARLY TECHNICAL MAGAZINE



## VISION- MISSION

### Institute Vision

To prepare skilled professionals with innovative, ethical, and entrepreneurial spirit.

### Institute Mission

**M-1:** Develop Skilled Professionals– Prepare individuals to excel in evolving global industries through training, hands-on experience, collaboration with industries, and continuous learning.

**M-2:** Promote Innovation- Encourage creative problem-solving through hands-on research and real-world projects.

**M-3:** Build Ethical Leaders- Instill integrity, inclusivity, and a commitment to social responsibility in all students.

**M-4:** Inculcate Entrepreneurial Spirit- Prepare individuals into leaders and entrepreneurs for creating and managing companies.

### Department Vision

To foster innovative, ethical, and entrepreneurial electrical engineers who will excel in global technology-driven industries.

### Department Mission

- M1** Equip students with technical knowledge and practical skills to excel in the evolving electrical and technology-driven industries.
- M2** Promote innovative problem-solving through hands-on projects, research, and collaboration with industry partners.
- M3** Foster ethical behavior, inclusivity, and social responsibility in students to prepare them for global challenges.
- M4** Develop leadership and entrepreneurial abilities in students to create impactful contributions in the field of electrical engineering.





## HOD'S MESSAGE



**Er. Anup Kumar Nanda**  
**Head of Department**  
**Electrical Engineering (Diploma)**

Dear Readers !!

It is with great pride and enthusiasm that I extend my warmest greetings to all of you as we present this edition of ***The Capital Currents***. This magazine serves as a vibrant platform to showcase insightful perspectives, thought-provoking discussions, and creative expressions that reflect the pulse of our dynamic community.

In an era where information flows rapidly, it is essential to engage in meaningful discourse and stay informed about the evolving socio-economic, cultural, and political landscapes. *The Capital Currents* strives to be more than just a publication—it is a voice, a bridge, and a catalyst for ideas that inspire progress.

I extend my heartfelt gratitude to our dedicated editorial team, contributors, and readers who continue to make this magazine a beacon of knowledge and inspiration. Your passion and commitment are what keep this publication thriving.

As you turn these pages, I hope you find articles that inform, stories that inspire, and perspectives that challenge conventional thought. Let us continue to foster intellectual curiosity and create a platform for meaningful dialogue.

Happy reading !!



## EDITOR'S MESSAGE



**Er. Surya Narayan Tripathy**  
**Chief Faculty Editor**  
**Electrical Engineering (Diploma)**

Dear Readers,

It is with great pleasure that I welcome you to the latest edition of ***The Capital Currents***, the technical magazine of the Department of Electrical Engineering. As we embrace a new year, this issue embodies the enthusiasm, innovation, and ground breaking advancements that define our field.

In this edition, we highlight pioneering research, remarkable student projects, and emerging technologies that are shaping the future of electrical engineering. From advancements in sustainable energy and smart grids to the integration of artificial intelligence in automation, each article reflects the transformative potential of our discipline.

I extend my heartfelt appreciation to our contributors, editorial team, and readers whose dedication and engagement make *The Capital Currents* a dynamic platform for knowledge exchange and discovery. Your continued support fuels the growth of this magazine and strengthens our academic and research community.

We hope this edition inspires, informs, and sparks new ideas, encouraging further exploration and innovation in the field of electrical engineering.

Happy reading!





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## SECTION-I: SCHOLARLY ARTICLES



*"What we know is a drop,  
what we don't know is an ocean."*

— Sir Isaac Newton



### FACULTY ARTICLES

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4.	Battery Management System (BMS)
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## Hydrogen Fuel Cells: A Clean Energy Solution

Hydrogen fuel cells are an emerging technology that converts chemical energy from hydrogen into electricity through an electrochemical process. Unlike traditional combustion-based power generation, hydrogen fuel cells offer a cleaner and more sustainable energy source, emitting only water vapor and heat as byproducts.

### Working Principle

A hydrogen fuel cell consists of three primary components:

**Anode:** The side where hydrogen gas ( $H_2$ ) is supplied.

**Cathode:** The side where oxygen ( $O_2$ ) is supplied, typically from the air.

**Electrolyte:** A membrane that allows protons (hydrogen ions) to pass through, while electrons are forced to travel through an external circuit, creating electricity.

When hydrogen is introduced to the anode, it splits into protons and electrons. The protons move through the electrolyte, while the electrons travel through the external circuit, generating electric power. At the cathode, oxygen molecules combine with the electrons and protons to form water ( $H_2O$ ), the only emission.

### Types of Hydrogen Fuel Cells

There are several types of hydrogen fuel cells, each suited for specific applications:

**PEMFC (Proton Exchange Membrane Fuel Cell):** Lightweight and compact, ideal for transportation and portable applications.

**SOFc (Solid Oxide Fuel Cell):** Operates at high temperatures, suitable for stationary power generation.

**AFC (Alkaline Fuel Cell):** Commonly used in space missions due to its high efficiency at low temperatures.

### Applications

Hydrogen fuel cells have wide-ranging applications, including:

**Transport:** Hydrogen-powered vehicles (cars, buses, trucks) can reduce reliance on fossil fuels and decrease greenhouse gas emissions.

**Stationary Power:** Used for backup power or in remote locations where grid connection is challenging.

**Portable Power:** For consumer electronics, providing a longer-lasting energy source than conventional batteries.



While hydrogen fuel cells offer a promising path to clean energy, there are several challenges:

**Hydrogen Production:** Currently, most hydrogen is produced from natural gas, a process that emits carbon. Green hydrogen, produced through electrolysis using renewable energy, is the ideal solution but remains costly.

**Storage and Distribution:** Hydrogen gas needs to be stored at high pressures or in liquid form, which presents logistical and safety challenges.

**Cost:** The technology remains expensive, though costs are expected to decrease as manufacturing scales up.

As technology improves, hydrogen fuel cells could play a significant role in decarbonizing sectors that are difficult to electrify, such as heavy transport and industrial processes, marking a key step toward a sustainable energy future.



Er. Ipsita Nanda  
Sr. Lect. EE (Diploma)

## **MATLAB: A Powerful Tool for Engineering and Scientific Computation**

MATLAB (Matrix Laboratory) is a high-level programming language and environment designed for numerical computation, data analysis, and algorithm development. It is widely used by engineers, scientists, and researchers for its versatility in handling a variety of technical computing tasks, from simple calculations to complex simulations.

### **Key Features of MATLAB**

**Matrix-Based Language:** MATLAB is designed around matrices, making it ideal for linear algebra computations, simulations, and scientific applications.

**Built-in Functions:** MATLAB comes with a rich library of built-in functions for mathematical operations, data analysis, signal processing, optimization, and more.

**Visualization:** MATLAB provides powerful tools for visualizing data, including 2D and 3D plotting, helping users interpret results easily.

**Toolboxes:** MATLAB offers specialized toolboxes for a range of fields like control systems, machine learning, image processing, statistics, and more.

**Integration:** It can integrate with other programming languages (such as C, C++, Java) and external hardware, enabling it to be used in real-world applications.



## Applications of MATLAB

**Signal Processing:** MATLAB is extensively used in signal processing to analyze, filter, and process signals. Its built-in functions allow engineers to apply Fourier transforms, filter design, and noise reduction techniques on both digital and analog signals.

**Image and Video Processing:** MATLAB's image processing toolbox provides algorithms for image enhancement, feature extraction, object recognition, and video analysis. It is commonly used in medical imaging, computer vision, and automation industries.

**Control Systems:** Engineers use MATLAB for modeling, analysis, and design of control systems. The Control System Toolbox helps simulate dynamic systems, analyze system stability, and design controllers.

**Machine Learning and Data Analytics:** With specialized toolboxes for machine learning and deep learning, MATLAB allows data scientists to build and train machine learning models, analyze large datasets, and extract useful patterns for prediction and classification tasks.

**Financial Modeling:** MATLAB is also used in financial engineering for quantitative analysis, portfolio optimization, risk management, and pricing of derivatives. Its ability to handle complex mathematical models makes it valuable in the finance sector.

**Simulations and Modelling:** MATLAB is frequently used for running simulations in physics, engineering, and other scientific fields. Its ability to simulate real-world systems, such as traffic flow, electrical circuits, or weather patterns, makes it a powerful tool for research and development.

**Robotics:** MATLAB is used to model robotic systems, simulate their behaviors, and develop algorithms for robot navigation, path planning, and control.

## Conclusion

MATLAB is a versatile and powerful tool for a broad range of applications, from basic calculations to advanced simulations. Its ease of use, extensive toolboxes, and high-level programming capabilities make it the go-to software for many professionals in fields like engineering, finance, and scientific research.



Er. Gopal Ch. Martha  
Sr. Lect. EE (Diploma)

## Universal Energy: A Concept for Sustainable Power

Universal energy refers to the idea of harnessing energy from various sources that are abundant, sustainable, and accessible globally. It encompasses the concept of creating and utilizing energy systems that can serve humanity's diverse needs while minimizing environmental impact. This broad idea includes renewable energy technologies and systems that aim to provide a clean, continuous, and universally available energy supply.

### Types of Universal Energy Sources

**Solar Energy:** Solar power is the most widely known and utilized form of universal energy. The Sun delivers vast amounts of energy every day, which can be captured using solar panels (photovoltaic cells) or solar thermal systems. Solar energy is renewable, abundant, and has a minimal environmental footprint.

**Wind Energy:** Wind turbines capture the kinetic energy of wind and convert it into electrical power. Wind energy is another renewable resource that can be harnessed globally. Wind farms, both onshore and offshore, are essential in the quest for universal clean energy.

**Hydropower:** Hydropower taps into the energy of flowing water, usually through dams or water turbines, to generate electricity. While large-scale hydroelectric plants are common, small-scale hydropower solutions can be implemented in remote areas, providing power in regions with rivers and streams.

**Geothermal Energy:** Geothermal power uses the heat from the Earth's core to generate electricity or provide direct heating. Geothermal energy is a stable and reliable source, especially in regions near tectonic plate boundaries where geothermal reservoirs are abundant.

**Biomass and Bioenergy:** Biomass energy is derived from organic materials such as plants, agricultural residues, and waste. When these materials are burned or converted to biogas, they release energy. Biomass can be a carbon-neutral source of power if managed sustainably, contributing to the universal energy mix.

**Hydrogen Energy:** Hydrogen, when used in fuel cells, can produce electricity with only water as a byproduct. As a clean energy carrier, hydrogen has the potential to be a

significant component of a universal energy strategy, particularly for sectors like transportation and industrial processes.

### The Future of Universal Energy

The goal of universal energy is to make clean, sustainable energy accessible to all parts of the world, reducing dependency on fossil fuels and mitigating climate change. Some key challenges include:

**Energy Storage:** Efficient and cost-effective energy storage systems are necessary to handle the intermittent nature of solar and wind power.

**Infrastructure:** Widespread adoption requires significant investment in energy infrastructure, including grids, transmission lines, and energy distribution systems.

**Energy Access:** Ensuring that remote or underdeveloped regions can access these energy resources is crucial for achieving global sustainability.

### Conclusion

Universal energy represents a vision for the future, where humanity can rely on clean, sustainable, and widely available energy sources. The integration of various renewable energy technologies, combined with advancements in storage and distribution, is crucial for achieving a sustainable global energy system. As research and innovation continue, universal energy could become a reality, reducing environmental impacts and supporting equitable growth across the globe.



Er. Anup Kumar Nanda  
Sr. Lect. EE (Diploma)

## Battery Management System (BMS)

A Battery Management System (BMS) is an electronic system designed to monitor, manage, and protect the components of a battery pack, ensuring safe and optimal performance. BMS is critical in applications such as electric vehicles (EVs), renewable energy storage systems, and consumer electronics, where the proper functioning of batteries directly impacts performance, lifespan, and safety.

### Key Functions of a BMS

**Monitoring Battery Health:** The BMS continuously tracks important parameters such as voltage, current, and temperature of individual cells in a battery pack. This helps identify cells that are underperforming or overcharging, preventing damage to the battery and ensuring efficient operation.

**State of Charge (SOC) Estimation:** The BMS calculates the State of Charge (SOC) to estimate the remaining capacity of the battery. This is essential for providing accurate



battery level indicators in devices like electric cars, ensuring users are aware of the available range or runtime.

**State of Health (SOH) Estimation:** The BMS evaluates the State of Health (SOH), which gives an indication of the overall battery condition and its ability to hold charge over time. SOH helps determine when a battery needs maintenance or replacement.

**Balancing:** Battery packs often consist of multiple cells that may have slight variations in voltage. The BMS uses balancing techniques to equalize the charge across cells, preventing overcharging or undercharging of individual cells, which can lead to shortened battery life or failure.

**Protection:** Safety is a critical aspect of battery management. The BMS protects the battery from hazardous conditions like over-voltage, over-current, short circuits, and extreme temperatures. It can disconnect the battery from the load or charging circuit if any of these conditions are detected, preventing potential damage or fire risks.

**Thermal Management:** Batteries generate heat during operation, especially during fast charging or discharging. The BMS monitors the temperature of cells and may activate cooling systems to maintain optimal operating temperatures, thus enhancing battery performance and longevity.

### **Applications of BMS**

**Electric Vehicles (EVs):** In electric cars, the BMS plays a crucial role in monitoring battery performance, extending battery life, and ensuring safe operation. It also optimizes the charging cycle to prevent damage from overcharging or deep discharging.

**Energy Storage Systems:** BMS is used in large-scale energy storage systems, such as those employed in renewable energy integration, to manage and optimize the storage of energy from solar or wind power.

**Consumer Electronics:** In devices like laptops, smartphones, and drones, BMS ensures the safety and efficient operation of lithium-ion batteries, preventing overcharging and maximizing battery lifespan.

**Medical Devices:** Many medical devices rely on rechargeable batteries, and a BMS ensures they remain operational and safe during use, with accurate state-of-charge readings for users.

### **Challenges and Future of BMS**

The development of more advanced BMS technology continues to evolve, addressing challenges such as:

**Cell Chemistry Compatibility:** Different battery chemistries (like lithium-ion, solid-state, and lithium iron phosphate) require specialized management approaches, which BMS must adapt to.

**Cost and Size:** As battery packs get larger and more complex, the BMS must be both cost-effective and compact while still offering advanced monitoring and protection capabilities.

**Integration with AI and IoT:** Future BMS may integrate with artificial intelligence (AI) and the Internet of Things (IoT) to predict battery failures, optimize energy consumption, and enable remote monitoring.

### Conclusion

The Battery Management System is a vital component in modern energy storage systems, ensuring the safety, efficiency, and longevity of batteries. With the increasing reliance on rechargeable batteries in sectors like electric vehicles, renewable energy storage, and consumer electronics, advanced BMS technology will continue to be a key factor in the development of reliable and sustainable battery-powered solutions.



Er. Lipsa Ray  
Sr. Lect. EE (Diploma)

## Silicon Devices: Backbone of Modern Electronics

Silicon devices are semiconductor-based components that have become fundamental to modern electronics. Silicon, a widely available and cost-effective material, serves as the foundation for most electronic devices, ranging from microprocessors to solar cells. Its electrical properties and ability to form integrated circuits make it indispensable in the development of modern technology.

### Key Properties of Silicon

Silicon is a group IV element with semiconductor properties, meaning it can conduct electricity under certain conditions but behaves like an insulator under others. This unique characteristic allows it to be used in a wide range of electronic components. Silicon's ability to form stable bonds and high tolerance to heat also contributes to its popularity in electronics manufacturing.

### Types of Silicon Devices

**Diodes:** A diode is one of the most basic silicon devices that allows current to flow in one direction only. It is used in applications like rectifiers, which convert alternating current (AC) to direct current (DC), and in protection circuits to prevent current from flowing backward and damaging sensitive components.

**Transistors:** Silicon transistors are the building blocks of modern electronics. Acting as switches or amplifiers, transistors control the flow of electrical current in circuits. The

most common types are Bipolar Junction Transistors (BJTs) and Field-Effect Transistors (FETs). They are crucial in microprocessors, digital circuits, and analog systems.

**Integrated Circuits (ICs):** Silicon ICs are compact assemblies of transistors, diodes, resistors, and capacitors embedded into a single chip. They are the core of modern computing devices, including microprocessors, memory chips, and power management ICs, providing functionality for everything from smartphones to complex industrial systems.

**Solar Cells:** Silicon-based solar cells are used to convert sunlight into electrical energy. The most common type, monocrystalline silicon solar cells, offers high efficiency and is widely used in residential and commercial solar power systems. Silicon's ability to absorb and convert light into electricity makes it a crucial material for renewable energy solutions.

**Sensors:** Silicon is also used in various sensor devices, such as temperature sensors, pressure sensors, and motion detectors. These sensors take advantage of silicon's semiconductor properties to detect changes in environmental conditions and convert them into electrical signals.

### **Applications of Silicon Devices**

**Computing and Communication:** Silicon devices are the backbone of the computing and telecommunications industry. Microprocessors, memory devices, and signal processors, all made using silicon, enable the functionality of computers, smartphones, and communication systems.

**Power Electronics:** Silicon devices like diodes, transistors, and thyristors are used in power conversion, regulation, and distribution, found in applications such as power supplies, electric vehicles, and renewable energy systems.

**Automotive Industry:** In modern vehicles, silicon-based devices are used in engine control units (ECUs), infotainment systems, autonomous driving technology, and electric vehicle (EV) batteries, playing a vital role in enhancing performance and safety.

**Healthcare:** Silicon devices are used in medical instruments such as pacemakers, diagnostic equipment, and monitoring systems. Sensors and microchips enable accurate readings and data collection for patient health management.



### Challenges and Future of Silicon Devices

**Scaling Limits:** As the demand for smaller and faster devices grows, silicon faces challenges in miniaturization due to its physical limitations, especially at the atomic scale.

**Heat Management:** Silicon-based devices can generate heat at high frequencies, requiring effective thermal management solutions.

**Alternative Materials:** Researchers are exploring alternative semiconductor materials like graphene and gallium nitride (GaN) for future applications, especially for high-power and high-frequency devices.

### Conclusion

Silicon devices are at the core of nearly every modern electronic system, from computing and communication to energy conversion and healthcare. Despite challenges in scaling and heat management, silicon continues to be the dominant material due to its versatility, cost-effectiveness, and established manufacturing processes. The ongoing development of silicon-based technologies, combined with innovations in material science, will likely continue to drive advancements in the electronics industry for the foreseeable future.



Er. Subrat Bhol  
Sr. Lect. EE (Diploma)



# Electrical Engineers Are All Set to Rule the World

## AC vs. DC: The Battle of Currents

When it comes to electricity, understanding the difference between Alternating Current (AC) and Direct Current (DC) is essential for electrical engineers and anyone interested in electrical systems. These two types of electrical current serve different purposes, and their applications are key to how we power our world today.

### Alternating Current (AC)

Alternating Current (AC) is the type of electrical current most commonly used in homes, businesses, and power grids. In AC, the flow of electrons changes direction periodically, reversing its flow back and forth at a regular frequency. This is in contrast to DC, where the current always flows in one direction. The frequency of AC is measured in Hertz (Hz), and in most countries, the standard frequency is 50 or 60 Hz. This means that the current changes direction 50 or 60 times per second.

The primary reason AC is preferred for power distribution is because it is more efficient to transmit over long distances. As the voltage can be easily stepped up or down using transformers, AC can travel across power lines with minimal energy loss. For instance, electricity is generated at a power plant, and before it is transmitted, it is stepped up to a higher voltage. This high voltage allows electricity to travel long distances with reduced losses. Once it reaches homes and businesses, the voltage is stepped down to a safer, usable level. This versatility makes AC the backbone of modern electrical grids.

### Direct Current (DC)

Direct Current (DC), on the other hand, flows in one continuous direction. The electrons in a DC circuit move steadily from the negative side to the positive side, creating a unidirectional flow of charge. This type of current is commonly used in devices such as batteries, smartphones, laptops, and electronic circuits. DC is well-suited for powering devices that require a stable and constant voltage, like the ones mentioned above.

In electronic devices, DC current powers components like microprocessors, sensors, and LED lights, providing precise and consistent power. Unlike AC, DC does not need to be transformed as it already provides the right kind of power for these sensitive circuits. In

fact, most electronic gadgets that run on batteries, such as smartphones and laptops, rely entirely on DC power, despite being charged via an AC supply.

### **AC vs. DC: Which One to Choose?**

The choice between AC and DC largely depends on the application. For long-distance transmission, AC is the preferred choice because of its efficiency in reducing energy loss and ease of voltage conversion. On the other hand, DC is ideal for low-voltage, portable applications, where a steady and consistent power source is necessary. This is why you'll often find AC used for electricity distribution in power grids, while DC powers small devices and electronics.

In the last few decades, there has been an increasing use of DC in modern technology, especially with the rise of renewable energy sources like solar panels and wind turbines, which naturally produce DC. To integrate these systems with the AC grid, inverters are used to convert DC into AC for transmission. On the flip side, some advanced technologies, such as high-voltage direct current (HVDC) transmission, are now being used for long-distance power transmission to reduce energy loss even further.

### **Conclusion**

Both AC and DC are crucial for powering different aspects of our modern world. While AC dominates in power transmission over long distances due to its efficiency, DC remains indispensable for portable electronics and precision applications. As electrical engineers, it's important to understand both forms of current, as they are used in different scenarios, and innovations in both fields continue to evolve. Whether designing a power grid or creating the next generation of smart devices, knowing the strengths and applications of AC and DC is fundamental to the work of electrical engineers.





## Safety First: Essential Electrical Safety Tips

Electrical engineers work with high voltages and powerful equipment, so safety is always a top priority. Here are some essential safety tips for students in the field:

**Use Insulated Tools:** Always use tools with insulated handles to avoid electric shocks.

- **Wear Personal Protective Equipment (PPE):** Safety gear like rubber gloves, boots, and goggles is crucial when working with live circuits.
- **Check for Faults:** Always verify that circuits are properly grounded and de-energized before working on them.
- **Follow Standard Protocols:** Adhere to safety codes and regulations to minimize the risk of accidents.
- **By prioritizing safety,** electrical engineers can ensure that they work efficiently without risking injury or damage to equipment.



## Digital Electronics: An Overview

Digital electronics is a branch of electronics that deals with circuits and systems that process discrete signals, typically represented by binary numbers (0s and 1s). Unlike analog electronics, which works with continuous signals, digital electronics manipulates signals that have a limited set of values, making them more reliable and less susceptible to noise.

### Basic Concepts:

At the heart of digital electronics are logic gates. These are the building blocks of digital circuits, and they perform basic operations such as AND, OR, NOT, NAND, NOR, XOR, and XNOR. When combined, these gates form complex circuits capable of performing calculations, storing data, and controlling devices.

### Components in Digital Electronics:

**Transistors:** These are the fundamental components used to create logic gates and act as switches that control the flow of electricity.

**Microcontrollers and Microprocessors:** These are integrated circuits (ICs) that serve as the brain of many electronic systems. They process instructions and control devices, from household appliances to complex computing systems.

**Flip-Flops:** These circuits store binary data and are key elements in memory devices like RAM and registers.

**Multiplexers, Demultiplexers, and Encoders/Decoders:** These components help manage data flow in digital systems, ensuring efficient data transmission and storage.

### Applications of Digital Electronics

Digital electronics has transformed numerous industries, including:

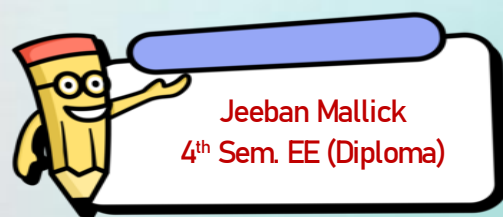
**Computing:** The most significant application, as it forms the basis for all modern computers, smartphones, and tablets.

**Communication:** Digital signal processing is crucial in telecommunications, including mobile networks and satellite communication.

**Consumer Electronics:** From televisions and radios to home automation systems, digital electronics enables the functionality of everyday gadgets.

**Automation:** In robotics and industrial automation, digital circuits control machines, sensors, and processes.

In summary, digital electronics is the foundation of modern technological advancements, offering high precision, reliability, and versatility in designing systems that power everything from computing to communication.



## Solar Energy: A Sustainable Power Source

Solar energy is the energy harnessed from the sun's rays, which is considered one of the most abundant and renewable sources of energy available. By converting sunlight into electricity or heat, solar energy offers a clean and sustainable alternative to traditional fossil fuels.

### How Solar Energy Works

Solar energy can be captured and converted in two main ways:

**Photovoltaic (PV) Cells:** These cells directly convert sunlight into electricity using semiconductor materials. When sunlight strikes the PV cells, it excites electrons, generating an electric current.

**Solar Thermal Systems:** These systems use mirrors or lenses to focus sunlight onto a receiver, heating a fluid that is then used to produce steam and drive turbines for electricity generation.

### Advantages of Solar Energy:

**Environmentally Friendly:** Solar energy produces no pollution or greenhouse gases during its production, making it one of the cleanest energy sources available.

**Renewable:** The sun provides an abundant, renewable supply of energy. Unlike fossil fuels, solar energy will not run out.

**Low Operating Costs:** After the initial installation, the cost of maintaining solar energy systems is relatively low, with minimal energy costs.

**Energy Independence:** Solar energy can reduce dependence on imported fuels and increase energy security, especially in regions with abundant sunlight.

### Applications of Solar Energy:

**Residential Use:** Solar panels are often installed on rooftops to provide electricity for homes and reduce energy bills.

**Commercial and Industrial Use:** Solar power can be used in businesses to reduce operational costs and promote sustainability.

**Remote Areas:** Solar energy is ideal for remote or off-grid areas where conventional power infrastructure is unavailable.

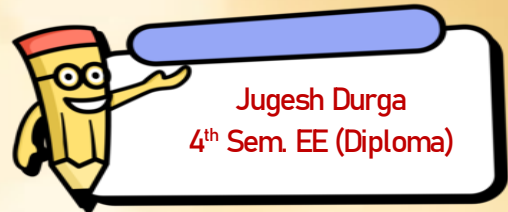
**Solar-Powered Vehicles:** Solar energy is also being used to power vehicles, from cars to boats and even airplanes.



## Challenges and Future of Solar Energy

While solar energy has numerous benefits, it faces challenges such as high initial installation costs and dependency on weather conditions. However, advancements in solar technology, battery storage, and government incentives are making solar power increasingly accessible and cost-effective.

In conclusion, solar energy is a key player in the shift toward renewable energy, offering a clean, reliable, and sustainable power source that can help reduce environmental impact and foster a more energy-independent future.



## Lithium-Ion Batteries: A Brief Overview

Lithium-ion (Li-ion) batteries are rechargeable energy storage devices widely used in modern technology. They work by moving lithium ions between the anode and cathode during charging and discharging, generating electric current to power devices.

### Advantages:

**High Energy Density:** Compact and powerful, making them ideal for electronics and electric vehicles.

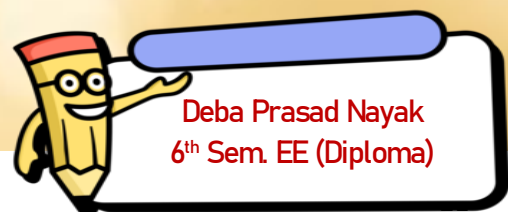
**Long Lifespan:** Li-ion batteries last longer and offer more charge cycles than many other batteries.

**Low Self-Discharge:** Retains charge when not in use.

**Eco-Friendly:** Safer for the environment when recycled properly.

**Applications:** Li-ion batteries are found in smartphones, laptops, electric vehicles, and renewable energy storage systems, thanks to their lightweight and efficient design.

**Challenges:** Despite their advantages, they face challenges such as safety concerns (overheating) and reliance on limited lithium resources. Ongoing research aims to improve battery safety and sustainability.



## Inverter: A Key Component in Power Conversion

An inverter is an electronic device that converts direct current (DC) into alternating current (AC). DC power, typically generated by sources like solar panels or stored in batteries, is not suitable for most household appliances or grid use, which require AC power. The inverter plays a critical role in enabling these systems to function effectively.

### How It Works:

An inverter takes DC power and uses various electronic components like transistors, capacitors, and transformers to convert it into AC power. This process involves switching the direction of current flow multiple times per second, typically at frequencies of 50Hz or 60Hz, to match the requirements of appliances or power grids.

### Types of Inverters:

**Pure Sine Wave Inverters:** These produce a smooth and consistent AC output, suitable for sensitive electronics.

**Modified Sine Wave Inverters:** These are simpler and more affordable but may not be suitable for all devices.

**Square Wave Inverters:** The simplest and least expensive but offer low-quality power output.

### Applications:

**Solar Power Systems:** Inverters convert DC from solar panels to AC for use in homes or businesses.

**Uninterruptible Power Supplies (UPS):** Inverters provide backup power during electrical outages.

**Electric Vehicles (EVs):** Inverters are used to convert DC from batteries to AC for the vehicle's motor.

### Benefits:

**Energy Efficiency:** Inverters optimize the use of energy by converting it efficiently.

**Sustainability:** In solar systems, inverters allow the use of renewable energy for daily power needs.

In conclusion, inverters are vital in modern energy systems, enabling the effective use of DC power in AC-driven applications, from renewable energy systems to backup power solutions.



## Artificial Intelligence: Transforming the Future

Artificial Intelligence (AI) refers to the development of machines and software that can perform tasks that typically require human intelligence, such as learning, problem-solving, decision-making, and understanding language. AI systems are designed to mimic cognitive functions like reasoning, perception, and adaptation, making them capable of performing complex tasks more efficiently than humans.

### How AI Works

AI uses algorithms, data, and models to recognize patterns, learn from experience, and make predictions. Machine learning, a subset of AI, allows systems to improve their performance over time by analyzing large sets of data and adjusting based on new information. Deep learning, a further advancement, uses neural networks to simulate the way the human brain processes information.

### Applications of AI:

**Healthcare:** AI is used in diagnostics, personalized medicine, and drug discovery.

**Automotive:** Self-driving cars use AI to navigate roads and make real-time decisions.

**Finance:** AI powers fraud detection, investment strategies, and customer service chatbots.

**Entertainment:** AI algorithms recommend movies, music, and social media content based on user preferences.

### Benefits:

**Efficiency:** AI can automate repetitive tasks, saving time and reducing errors.

**Innovation:** AI enables the creation of new products, services, and solutions in various fields.

**Improved Decision-Making:** AI processes vast amounts of data to provide insights that support better decisions.

**Challenges and Future:** While AI holds immense potential, challenges like ethical concerns, job displacement, and data privacy need to be addressed. The future of AI involves advancing towards general AI, which could perform any cognitive task a human can do.

In conclusion, AI is a rapidly evolving technology that is shaping various industries and everyday life, offering both opportunities and challenges as it continues to transform the world.





## Data Analytics: Unlocking Insights for Better Decision-Making

Data analytics refers to the process of examining large sets of data to uncover hidden patterns, correlations, and trends that can help businesses and organizations make informed decisions. By transforming raw data into meaningful insights, data analytics plays a crucial role in improving efficiency, driving growth, and solving complex problems.

### How Data Analytics Works:

Data analytics involves several key steps:

**Data Collection:** Gathering data from various sources, such as databases, sensors, or social media.

**Data Cleaning:** Ensuring the data is accurate, complete, and free from errors.

**Data Analysis:** Using statistical tools and algorithms to identify patterns and trends.

**Visualization:** Presenting the findings in easy-to-understand formats, like graphs or dashboards, for decision-makers.

### Applications of Data Analytics:

**Business:** Helps companies optimize operations, enhance customer experiences, and increase profitability.

**Healthcare:** Assists in patient care, predicting outbreaks, and managing resources.

**Sports:** Used to analyze player performance, team strategies, and fan engagement.

**Marketing:** Helps businesses understand consumer behavior, tailor campaigns, and improve targeting.

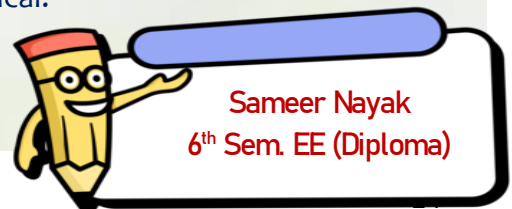
### Benefits:

**Informed Decisions:** Data-driven insights lead to better and more objective decision-making.

**Efficiency:** Data analytics helps organizations streamline operations and identify cost-saving opportunities.

**Competitive Advantage:** Organizations can stay ahead by predicting market trends and customer needs.

In conclusion, data analytics is a powerful tool that turns raw data into actionable insights, driving smarter decisions across a wide range of industries. As data continues to grow, the role of analytics in shaping the future becomes more critical.



Sameer Nayak  
6<sup>th</sup> Sem. EE (Diploma)

# Art Section

🎨 Welcome to the Art Section of our Departmental magazine! ✍️

Art is not just about colors on a canvas or lines on a page; it's about expressing the depths of our imagination, emotions, and perspectives. In this section, we celebrate creativity in its myriad forms – from traditional paintings to digital art, from sculpture to photography, and everything in between.

Through the strokes of our brushes, the clicks of our cameras, and the chiseling of our sculptures, we aim to captivate, inspire, and provoke thought. Each piece featured here tells a story, reflects a moment, or expresses an idea unique to its creator.

Art has the power to transcend boundaries, ignite conversations, and evoke profound emotions. So, immerse yourself in the world of creativity, let your imagination roam free, and join us on a journey through the boundless realms of artistic expression.

We invite you to explore, appreciate, and engage with the works showcased in this section. Let the colors, shapes, and textures speak to you, and may they inspire you to discover your own artistic voice.

Enjoy the journey!



Ejikel Raita, 6<sup>th</sup> Sem. Diploma EE

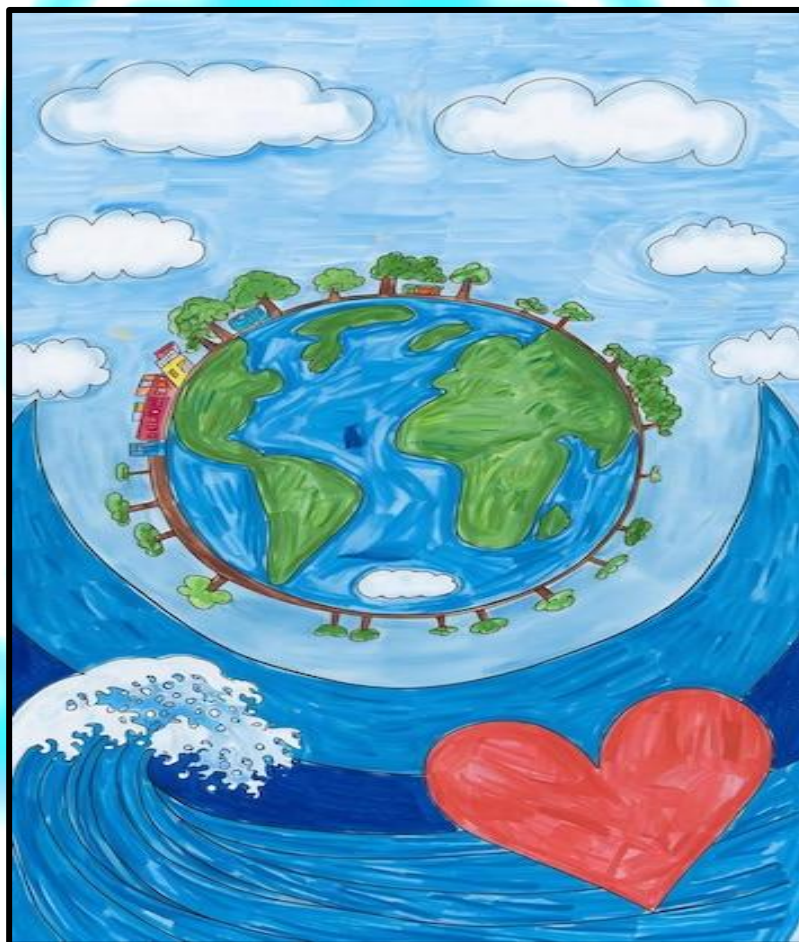


Kaberi Mallick, 4<sup>th</sup> Sem. Diploma EE



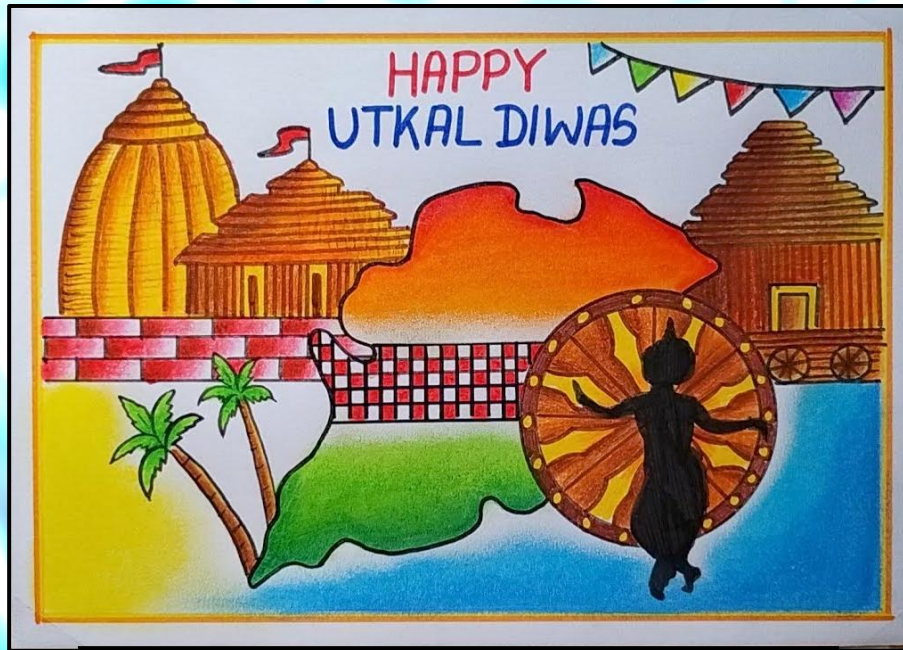


**Sandip Digal, 4<sup>th</sup> Sem. Diploma EE**



**Jugesh Durga , 4<sup>th</sup> Sem. Diploma EE**





**Debasish Mohapatra, 2nd Sem. Diploma EE**



**Srabani Mallick , 2nd Sem. Diploma EE**



### ख्वाबों की उड़ान

चाँदनी रातों में, सपने जो बुनते,  
मन के आंगन में, तारों सा झिलमिलाते।  
हवा संग उड़ते, परवाज़ नई,  
ख्वाब हमारे, हैं आसमान की गली।

हर ठोकर से, हिम्मत जो बढ़े,  
कदम-कदम पर, रोशनी मिले,  
दिल की लौ, यूँ ही सदा जले।

सूरज सा जलना, पर रोशनी देना,  
अंधेरी राहों में, दीपक सा रहना।  
खुद पे यक़ीन, हर हाल में रखना,  
ख्वाबों की दुनिया को, सच में बदलना।

Champeswar Meher, 6<sup>th</sup> Sem. Diploma EE

### माँ का प्यार

माँ की ममता, सागर से गहरी,  
उसकी मूरत, चाँद से सुनहरी।  
हाथों की छाँव, सुख का साया,  
दुनिया में माँ से, कोई ना पाया।

दर्द हमारा, माँ समझ जाए,  
बिन बोले ही सब कुछ कह जाए।  
ईश्वर का रूप है, ममता की खान,  
माँ ही तो है, जीवन की जान।

Jeeban Mallik, 4<sup>th</sup> Sem. Diploma EE



## "ଜୀବନର ପଥ"

ଏ ଜୀବନ ଏକ ସାଧା ରାସ୍ତା,  
ଗୋଟିଏ ଦିନ ହସ ଏବଂ ଅନ୍ୟ ଦିନ ଆଂସୁ।  
ସଫଳତା ଅଧିକାର କିନ୍ତୁ କିଏ ଅଧିକାରୀ,  
ସେହି ଲକ୍ଷ୍ୟ ପ୍ରାପ୍ତି ପାଇଁ ହେବା ଉତ୍ସାହୀ।

ମନରେ ହେଉ ଦୃଢ଼, ନିଜେ ହେଉ ସମର୍ଥ,  
ଏହି ପ୍ରପଞ୍ଚ ଏକ ଅଭୁତ ଅଭିଯାନ।  
ଅନ୍ଧାର ମଧ୍ୟରେ ଆଶା ଦିପଂବୁଲି,  
ଅଗ୍ରସର ହେଉ ତୁମେ, ନାହିଁ କୌଣସି ଭୟ।

ଏହି ପଥରେ ରହିଛି ଆଘାତ ଅନେକ,  
ଯେଉଁଠି ବାଘ ଏବଂ ସେଇ ହିଁ ଶେଖଳ।  
ଏକ ଅନ୍ଧକାରି ରାତି ମଧ୍ୟରେ ମେଘର ଅତିବ,  
ଅଗ୍ରଗତି ଅନିବାର୍ଯ୍ୟ, ଏହି ଜୀବନ ଏକ ଗୀତ।

ତୁମେ ନିଜର ଲକ୍ଷ୍ୟ ବିସର୍ଜନ କରନ୍ତୁ ନାହିଁ,  
ସଂଘର୍ଷରେ ମିଳେ ଜୟର ଅଧିକାର।  
ମନେ ଧର ଜୟ ତୋ ନିଶ୍ଚିତ,  
ମେହନତ ଏବଂ ସହନଶୀଳତା ହେଉ ତୋର ଅସ୍ତ୍ର।

ସେଇ ଦିନ ଆସିବ, ଯେତେବେଳେ ତୁମେ ଜିତିବ,  
ତୁମର ପଥରେ ନ ଥିବ ଅନ୍ଧକାର।  
ସେଇ ଅସାଧାରଣ ଅବସର ଆସିବ ନିଶ୍ଚୟ,  
ଯେତେବେଳେ ସଫଳତା ହସି କହିବ –  
"ତୁମେ ଜିତିଲ, ତୁମେ ସଫଳ!"

Ajay Mallick, 4<sup>th</sup> Sem. Diploma EE

## The River's Journey

A river flows, so wild, so free,  
Through mountain peaks, down to the sea.  
It carves the land, it shapes the stone,  
Yet never stops, though all alone.

It starts as just a tiny stream,  
A whisper, soft—a fragile dream.  
Yet step by step, it finds its way,  
Through night and storm, gold-lit day.

It sings to trees, it feeds the land,  
It shapes the earth with patient hands.  
It knows no fear, it knows no rest,  
Yet every step, it gives its best.

The river bends, the river sways,  
Yet never once does it delay.  
It meets the rocks, it breaks and turns,  
But through it all, it flows and learns.

And when at last, it meets the tide,  
It greets the sea, arms open wide.  
For every twist, for every bend,  
Has led it home, where journeys end.

Oh, be the river, brave and true,  
Let nothing stand in front of you.  
Keep flowing on, don't be afraid,  
For every path, a mark is made.



## The Road of Life

The road of life is long and wide,  
A winding path where dreams reside.  
With golden and stormy nights,  
Through joy and pain, we light.

We start so young, with hearts so free,  
No fear of what the world might be.  
Each step we take, a lesson learned,  
Some bridges crossed, some pages turned.

The sun may shine, the birds may sing,  
Or thunder roar with bitter sting.  
Yet through it all, we walk ahead,  
With hope alive and courage fed.

Friends we meet, the hands we hold,  
Some stay with us, some tales grow old.  
Yet every soul we come to know,  
Leaves in our heart a spark to glow.

The mountain peaks, the valleys low,  
The trials fierce, yet still we grow.  
For strength is found in weary bones,  
In whispered prayers, dreams alone.

And when at last the road runs thin,  
When twilight's glow is setting in,  
We look behind, we smile, we see—  
A life well-lived, a soul set free.



Ajay Mohanta  
4<sup>th</sup> Sem. Diploma EE

Ghanasyam Durga  
4<sup>th</sup> Sem. Diploma EE

## Ode to the Ocean

Oh, mighty ocean, vast and deep,  
Your secrets in your waters keep.  
You touch the shore, then slip away,  
A dance you've danced since time's first day.

Your voice, a song both fierce and kind,  
A rhythm set to ease the mind.  
You call to hearts, both lost and free,  
A whisper soft, "Come, sail with me."

You know the storms, you know the tide,  
The shifting moods you cannot hide.  
Yet even when the waves run wild,  
You cradle still the dreaming child.

You mirror stars on moonlit nights,  
You glow beneath the northern lights.  
A restless force, yet calm embrace,  
A home to life, a boundless space.

The sailors come, the ships will go,  
Yet still you rise, yet still you flow.  
And when all else has turned to sand,  
Your waters stretch, your waves expand.

Oh, mighty ocean, fierce and wide,  
Forever calling with your tide.  
In your embrace, all worries cease,  
A heart that beats in endless peace.



## The Eternal Journey

The path unfolds beneath my feet,  
A tale of trials, bold and sweet.  
The mountains rise, the rivers run,  
Each day begun, yet never done.

I walk through fields of golden light,  
Where flowers bloom in colors bright.  
I hear the whispers in the air,  
The echoes soft of love and care.

The winds may shift, the seasons change,  
The sky turns dark, the stars rearrange.  
Yet through it all, I march ahead,  
Through dust and dawn, through hope and dread.

The hands I've held, the tears I've shed,  
The words once spoken, the prayers once said—  
They shape my soul, they carve my way,  
A thousand moments, night and day.

And though the road is steep and long,  
I carry forward, brave and strong.  
For in the journey, life is found,  
In every loss, in every sound.

No final step, no true goodbye,  
For footprints fade, yet dreams will fly.  
Beyond the hills, beyond the sea,  
The path goes on eternally.





### **A Love That Stayed**

The rain drummed softly against the window as Aisha stood in the dimly lit bookstore, running her fingers over the worn pages of an old novel. She wasn't reading—her thoughts were elsewhere, tangled in memories of him.

Kabir.

It had been years since they had last spoken, yet his presence still lingered in the quiet corners of her heart. They had been inseparable once, sharing dreams over late-night coffee and stolen moments under city lights. But life had pulled them in different directions—careers, responsibilities, and unspoken words building an invisible wall between them.

A bell chimed at the entrance, and a familiar voice made her freeze.

"Aisha?"

She turned, her breath hitching as she met his gaze. Kabir stood there, older, perhaps wiser, but the warmth in his eyes was unchanged.

"You still come here," he said, a small smile playing on his lips.

She swallowed the lump in her throat. "And you still remember."

He stepped closer, hesitant. "I never forgot."

The weight of lost time pressed between them, yet in that moment, it didn't matter. Because love, real love, didn't fade—it stayed, waiting patiently, even when buried beneath years of silence.

She let out a shaky breath. "Would you like to sit and catch up?"

His smile widened. "I'd love to."

As they sat by the window, the rain continued to fall, washing away the years between them. And just like that, love found its way back home.

**Narayan Badajena**  
**4th Sem. Diploma EE**

## A Mother's Journey

The rain pounded against the tin roof of the small house, the rhythmic tapping a lullaby for the little girl curled up on the tattered mattress. Her mother, Meera, sat beside her, running her fingers through her daughter's damp hair, humming a tune from long ago. The candle on the wooden table flickered, casting shadows on the mud walls.

Aanya was only six, but she already knew what struggle looked like. She had seen it in her mother's eyes, in her tired smile, in the way her hands trembled when she counted the last few coins before buying their dinner. Yet, she never saw despair. Meera's love was a fortress, shielding Aanya from the hardships that lurked beyond their home.

Meera had once dreamt of a different life. As a child, she had sat by the river, weaving stories of castles and queens, of lands where the sky was limitless. But dreams had a way of slipping through the cracks of reality. She had married young, believing in promises whispered under moonlit nights, only to find herself abandoned with a child to raise alone.

But she did not break.

Every morning, before the first rays of the sun painted the sky, Meera would tie her hair back, wrap her saree tightly around her, and set off to work. She did everything she could—washing clothes, cleaning homes, selling vegetables at the market. Her hands bore the scars of her labor, but she never let them touch Aanya.

One evening, as Meera returned home, exhausted from the day, she found Aanya sitting on the floor with a book in her lap. The pages were old, the ink faded, but the girl's eyes shone with excitement.

"Where did you get this, Aanya?" Meera asked, kneeling beside her.

"From the school library, Amma," Aanya replied, her voice filled with joy. "The teacher let me borrow it. I want to learn, Amma. I want to go to school every day."

Meera's heart ached. School meant fees, books, uniforms—things she could barely afford. But as she looked into her daughter's hopeful eyes, she made a silent promise.

That night, while Aanya slept peacefully, Meera sat by the candlelight, stitching blouses for a neighbor. She worked until her fingers were sore, her vision blurred, and the candle melted into nothing.

Months passed. Meera saved every coin she could, sacrificing her own meals at times, ensuring Aanya had everything she needed for school. She watched with pride as her daughter's world expanded beyond their small home—into classrooms filled with words and numbers, into stories of distant lands and endless possibilities. One evening, Aanya came running home, her face flushed with excitement.

"Amma! The teacher says I am the best in class! She says I can get a scholarship if I keep studying hard!"

Tears welled in Meera's eyes. She pulled her daughter into her arms, whispering a silent prayer of gratitude.

Years passed, and Aanya grew into a bright young woman. She studied under streetlights when the electricity failed, wrote on the backs of old newspapers when notebooks were scarce. Meera continued to work tirelessly, her once-black hair now streaked with silver, but her spirit unbroken.

Then, the day came. Aanya, dressed in a crisp white uniform, stood at the bus station, a letter of acceptance to a prestigious university clutched in her hands.

"Amma, I don't want to leave you alone," she said, her voice trembling.

Meera cupped her daughter's face. "You are my dream, Aanya. Go, fly. Make a life for yourself. I will always be here."

As the bus pulled away, Meera stood watching, pride and longing intertwined in her heart. She wiped her tears and walked back home, knowing she had given Aanya the wings she never had.

Years later, Aanya returned—not as a helpless child, but as a woman who had made something of herself. She wrapped her arms around her mother, now frail but still strong, and whispered, "You are the reason I am here, Amma."

Meera smiled. She had never been to castles or distant lands, but she had built a kingdom in her daughter's success.

And that was enough.

**Trilochan Kandi**  
**6th Sem. Diploma EE**



## Unspoken Feelings

The café was crowded, yet Maya felt alone. She stirred her coffee absentmindedly, her thoughts drowning in the swirl of milk and espresso. Across the table, Aarav sat in silence, his fingers tapping against the ceramic cup.

They had been best friends for years, always finding comfort in each other's presence. But tonight, there was an unfamiliar tension in the air—something unspoken, something fragile.

Maya had always believed that feelings should be voiced, yet here she was, terrified to speak. Her heart beat against her ribs as she stole a glance at Aarav. His gaze was distant, lost in thoughts she couldn't reach.

"You're quiet today," she finally said, forcing a smile.

Aarav exhaled softly, his fingers tightening around his cup. "Maya... there's something I need to tell you."

Her heart clenched. She knew what was coming. Maybe he had met someone. Maybe he was moving away. A thousand possibilities ran through her mind, each one heavier than the last.

But then, he looked at her—really looked at her—and said, "I love you."

The words hung between them, delicate yet powerful. Maya's breath caught, her eyes searching his for uncertainty, but all she saw was raw honesty.

Tears stung her eyes as she whispered, "I love you too."

Aarav smiled, a mixture of relief and joy washing over him. And just like that, the silence between them no longer felt heavy. It felt like home.

Maya reached across the table, her fingers brushing against his. "Why did it take you so long to tell me?" she asked.

He chuckled, shaking his head. "Because I was afraid of losing you."

She squeezed his hand. "You never had to be."

Sometimes, love isn't about finding the right words. It's about finding the right moment.