



Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
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SCHOOL OF ELECTRICAL AND COMMUNICATION

**DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING**

Spark Magazine

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Foreword



Col. Prof. Vel. Dr. R. Rangarajan
Founder President & Chancellor



Dr. Mrs. Sagunthala Rangarajan
Foundress President

We remain committed to building an educational environment that nurtures knowledge, character, innovation, and excellence. Our institution continues to encourage students and faculty to pursue meaningful academic, research, and technological endeavors, supported by modern infrastructure, well-equipped laboratories, and a dedicated faculty. The Department of Electrical and Electronics Engineering reflects this vision through its academic achievements, research initiatives, funded projects, industry collaborations, and the accomplishments of its students and faculty.

Foreword



Mrs. Rangarajan Mahalakshmi Kishore
Chairperson & Managing Trustee

Delighted to witness the achievements of faculty and students across academic and research activities, the Chairperson congratulates the entire team on the effort behind this report and commends the department for producing talent-driven, innovative engineers to meet society's new and challenging issues.



Foreword



Prof. Dr. Rajat Gupta
Vice Chancellor

I am delighted to present the latest edition of Spark, the flagship magazine of the EEE Department. This magazine reflects our continuous pursuit of research excellence, creativity, co-curricular activity and technical learning of our students. Kudos to the editorial team, faculty, and brilliant students whose hard work and contributions made this edition possible.



Prof. Dr. E. Kannan
Registrar

I warmly congratulate the EEE Department on launching this vibrant edition of Spark. This platform beautifully captures the dynamic activities, student achievements, and academic excellence of the department. I wish the EEE team continued success in inspiring our community through such creative and meaningful initiatives.



Message from Dean and Head of the Department

Dr. R. S. Valarmathi

Professor & Dean
School Of Electrical and Communication



The School continues to make remarkable progress, driven by the achievements of our faculty, students and staff in cutting-edge research, academic excellence, and industry collaboration. Spark, the magazine of EEE department serves as a wonderful window into this journey—reflecting our focus on innovation, hands-on learning, and community impact. I commend the entire team for shaping our students into future-ready professionals and bringing these milestones to light.

Dr. K. Karunanithi

Professor & Head
Department of Electrical and Electronics Engineering



It is with great pleasure and immense pride that I present Spark, the official magazine of the Department of Electrical and Electronics Engineering. I invite you to explore these pages to discover the remarkable achievements and creative brilliance within our department. Together, as we continue to push boundaries, we look forward to a vibrant future driven by transformative education, innovative research, and impactful contributions to the world of EEE.

VISION OF THE DEPARTMENT

To provide intellectual curiosity in the field of Electrical and Electronics engineering that produces skilled interdisciplinary engineers to serve the society.

MISSION OF THE DEPARTMENT

M1: To inculcate knowledge among the students through comprehensive curriculum.

M2: To enrich the academic experience in terms of flexibility, teamwork, design skills, practice and industrial trainings.

M3: To produce competent graduates suitable for a successful career in Industry and Research.

PROGRAMME EDUCATIONAL OBJECTIVE

PEO1: Design and analyse electrical and electronic systems by applying the knowledge of mathematics and engineering.

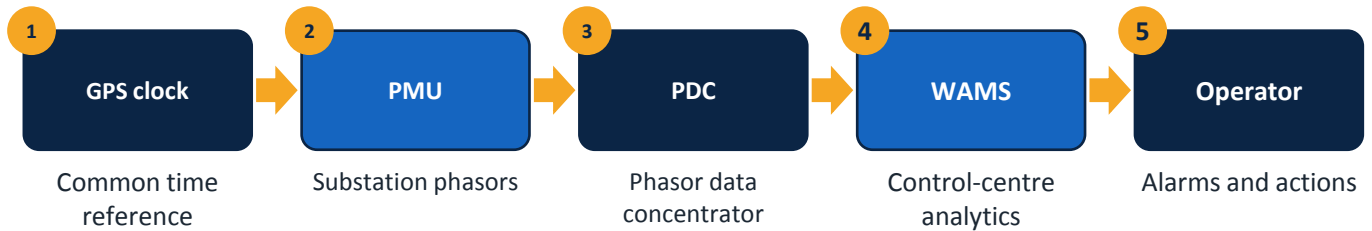
PEO2: Provide practical solution to multidisciplinary societal problems through innovative ideas.

PEO3: Secure positions and continue as valued, creative and proficient employees in a wide variety of fields and industries for a rewarding career.



PMUs and Wide Area Measurement Systems (WAMS)

Seeing the whole grid in real time



A phasor measurement unit (PMU) measures voltage and current as phasors, with magnitude and phase angle, and time-stamps each sample using GPS. Reports arrive tens of times per second, compared with several seconds for traditional SCADA, so operators can see fast dynamics such as power oscillations. Data from many PMUs flow to phasor data concentrators and then to a wide area measurement system (WAMS) at the control centre. Applications include oscillation monitoring, state estimation, islanding detection and post-event analysis. Because measurements from far-apart substations share one time reference, they can be compared directly, giving operators a live picture of grid stress and stability.

KEY POINTS

- GPS-synchronised phasor measurements
- Tens of reports per second versus SCADA scans
- Oscillation monitoring and situational awareness

CONCEPT · SYNCHROPHASOR

A synchrophasor is a phasor tagged with a precise common time, so distant measurements line up exactly.

IoT-Based Monitoring of Electrical Power Systems

Connecting sensors to decisions



Internet of Things (IoT) monitoring places low-cost sensors on power equipment to measure voltage, current, temperature, vibration, oil level or gas content. A microcontroller or edge gateway filters the data and sends it over Wi-Fi, LoRa, NB-IoT or cellular links, often using lightweight protocols such as MQTT, to a cloud platform where dashboards, analytics and alerts turn readings into action. Typical uses include transformer and feeder monitoring, solar plant performance, smart meters and early detection of faults or theft. Good designs must handle cybersecurity, communication delay, sensor calibration and the power supply of remote devices.

KEY POINTS

- Sensors, edge gateway, network and cloud
- Used on transformers, feeders and solar plants
- Security and reliability are key design issues

CONCEPT · MQTT

A lightweight publish/subscribe messaging protocol that suits small devices and unreliable networks.

Demand Response and Intelligent Energy Management

Letting consumers help balance the grid

Price-based DR

- Time-of-use tariffs
- Real-time or dynamic pricing
- Critical peak pricing
- Consumer chooses when to use

Incentive-based DR

- Direct load control
- Interruptible / curtailable load
- Payments for reducing demand
- Utility or aggregator dispatches

Demand response (DR) means consumers change when or how much electricity they use in response to price or grid signals. Price-based programmes, such as time-of-use and real-time tariffs, encourage shifting use away from peaks. Incentive-based programmes, such as direct load control and interruptible loads, pay participants to reduce demand when the grid needs it. Intelligent energy management systems automate this using smart meters, forecasts and controllers that shift flexible loads like water heaters, air conditioners, EV chargers and industrial processes without disturbing comfort. DR lowers peak demand, reduces costs and helps absorb variable solar and wind, but it depends on consumer acceptance and reliable communication.

KEY POINTS

- Peak shaving and lower energy cost
- Helps integrate solar and wind
- Needs smart meters and consumer participation

CONCEPT · PEAK SHAVING

Cutting the highest demand can avoid building expensive generation and network capacity used only a few hours a year.

AI-Based Energy Management Systems for Microgrids

Smarter dispatch under uncertainty



A microgrid combines local generation such as solar and wind, batteries, backup sources and loads, and can operate connected to the main grid or islanded. Its energy management system (EMS) decides, minute by minute, which source supplies which load and when the battery charges or discharges. machine-learning models forecast load, solar or reinforcement-learning methods schedule resources to minimise cost, emissions or outages despite forecast errors. Control is usually hierarchical, with fast local control, a supervisory layer for secondary control and an economic layer for scheduling.

KEY POINTS

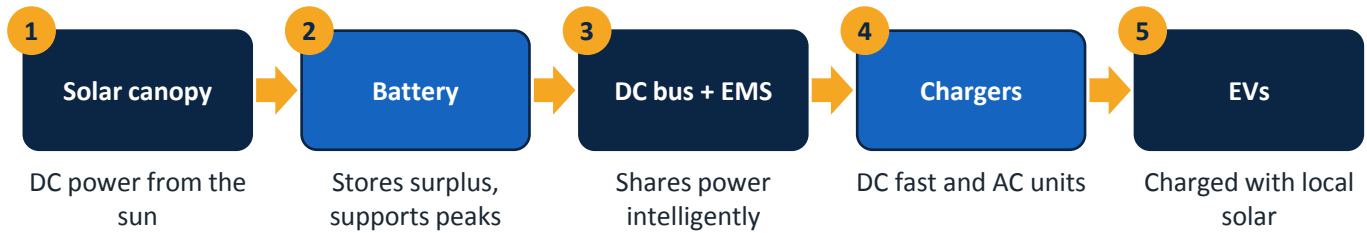
- Forecasts load, solar and wind with ML
- Optimises battery and generator scheduling
- Works in grid-connected and islanded modes

CONCEPT · ISLANDING

When the main grid fails, a microgrid can disconnect and keep local loads running on its own sources.

Solar PV + Battery Storage for EV Charging Stations

Cleaner, cheaper and gentler on the grid



Fast chargers draw large power in short bursts, which can strain the local network and create high demand charges. Adding rooftop or canopy solar with a stationary battery softens those peaks and lets the station use more of its own clean energy. In a typical design, PV, battery and chargers share a DC bus managed by an energy management system. The battery charges from surplus solar or cheap grid power and supports the chargers when several vehicles arrive together. Correct sizing depends on traffic pattern, tariff structure and available space, and the same battery can also provide backup during outages.

KEY POINTS

- Reduces peak demand from the grid
- Increases use of local solar energy
- Battery buffers bursts of fast charging

CONCEPT · DEMAND CHARGE

Many commercial tariffs charge for the highest power drawn, not only energy used, so trimming peaks saves money.

Wireless EV Charging Technology

Charging without a cable



Wireless charging uses inductive power transfer: a coil in a ground pad, driven by a high-frequency inverter, creates an alternating magnetic field, and a matching coil under the vehicle picks it up. Resonant compensation circuits tune both coils so power moves efficiently across the air gap, and a rectifier feeds the battery. The SAE J2954 standard uses an operating frequency of about 85 kHz, with light-duty power classes up to 11 kW. Benefits are convenience and suitability for autonomous vehicles; research also explores charging while driving. Challenges include coil alignment, cost, foreign-object exposure and slightly lower efficiency than a plug.

KEY POINTS

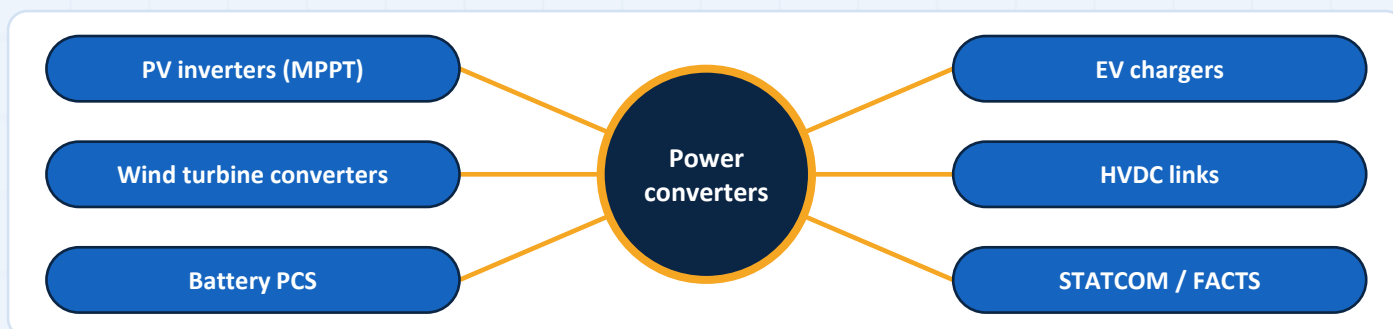
- Ground and vehicle coils linked by a magnetic field
- SAE J2954: about 85 kHz, up to 11 kW
- Alignment and foreign-object detection matter

CONCEPT · RESONANCE

Tuning both coils to the same frequency lets power cross the air gap with far lower losses.

Power Electronics for the Energy Transition

The role of converters and inverters in modern grids



Nearly every clean-energy technology meets the grid through power electronics. Rectifiers, DC–DC converters and inverters shape voltage, current and frequency so that sources with different characteristics can work together. PV inverters extract maximum power through MPPT, wind turbines use back-to-back converters, battery systems use a power conversion system, EV chargers convert AC to DC, and HVDC links and STATCOMs use voltage-source converters for long-distance transfer and voltage support. This gives fast, precise control, but also brings challenges such as harmonics, low inertia and the need for grid-forming capability. Wide-bandgap devices and modular designs are shaping the next generation.

KEY POINTS

- Converters connect PV, wind, storage and EVs
- Fast control, but low inertia and harmonics
- Grid-forming and wide-bandgap are the trends

CONCEPT · MPPT

Maximum power point tracking adjusts the converter so a solar array always delivers the most power available.

Silicon Carbide (SiC) and Gallium Nitride (GaN) Power Devices

Wide-bandgap semiconductors behind efficient converters

	Silicon (Si)	Silicon carbide (SiC)	Gallium nitride (GaN)
Bandgap	About 1.1 eV	About 3.3 eV	About 3.4 eV
Best suited to	General-purpose converters	High voltage and high power	Lower voltage, very high frequency
Typical uses	Drives, rectifiers	EV inverters, PV, fast chargers	Compact chargers, data-centre supplies

Silicon has a bandgap of about 1.1 eV, whereas SiC and GaN have bandgaps of roughly 3.3 eV and 3.4 eV. This wide bandgap gives a higher breakdown field, allowing devices that switch faster, waste less energy and tolerate higher temperatures. SiC MOSFETs suit higher voltages and power levels: EV traction inverters, fast chargers, PV inverters and industrial drives. GaN transistors excel at lower voltages and very high switching frequencies, enabling compact chargers and data-centre power supplies. Higher frequency shrinks magnetics and capacitors, but demands careful layout and gate driving.

KEY POINTS

- Lower switching and conduction losses
- Higher frequency means smaller passive parts
- SiC for high power, GaN for compact designs

CONCEPT · BANDGAP

The bandgap is the energy needed to free an electron. A wider gap lets a thinner layer block higher voltage.

“మా ఇల్లు”

మంచి భవిష్యత్తు కోసం
ఊరిని వదిలి వచ్చాను...
కానీ,
మరో జన్మ అంటూ ఒకటుంటే
నా ఊరిని వదిలి రానని
మనసులోనే మాటిచుకున్నాను.

రోజు ఎంత చెడ్డదైనా పర్వాలేదు...
పడుకునే ముందు
ఒక్కసారి అమ్మతో మాట్లాడితే చాలు
ఆ రోజు మళ్ళీ పూర్తయినట్టే ఉంటుంది.

వాళ్ళతో గడిపిన చిన్న చిన్న క్షణాలే
ఇప్పుడు పెద్ద జ్ఞాపకాలయ్యాయి...
అమ్మ పిలుపు, నాన్న మాట,
ఇంట్లోని ఆ చిన్న గొడవలు—
అప్పుడు వాటి వలువ తెలియలేదు,
ఇప్పుడు అవే కావాలనిపిస్తున్నాయి.

ఇల్లు అక్కడే ఉంది...
ఊరు అక్కడే ఉంది...
అమ్మా నాన్నా కూడా అక్కడే ఉన్నారు

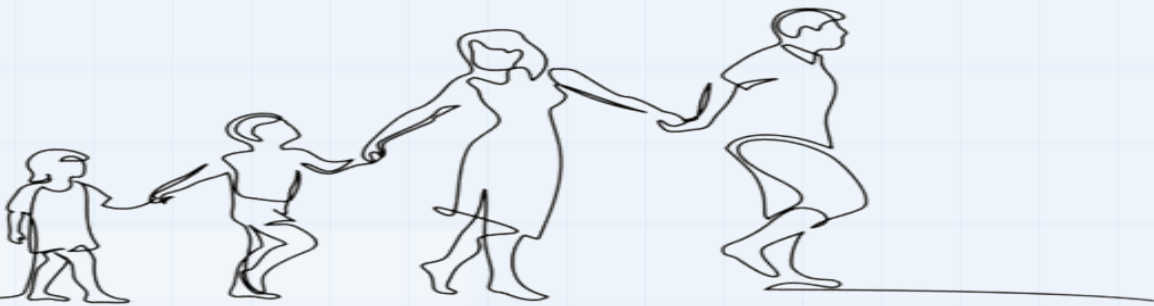
పగలంతా స్నేహితుల మధ్య,
కాలేజీ పనుల్లో, నవ్వుల్లో గడిచిపోతుంది...
కానీ అర్ధరాత్రి దాటితే—
అమ్మా... నాన్నా... అంటూ
జ్ఞాపకాలు మాత్రం నిద్రపోనివ్వవు.

మన కోసం వాళ్లు
మంచి జీవితాన్ని నిర్మిస్తున్నారు...
కానీ వాళ్ళకు తెలియదు—
మన జీవితంలో వాళ్లే
అత్యంత మంచి భాగమని

ఒకప్పుడు మన ఇంటికి మనమే పిల్లలం...
ఇప్పుడు మాత్రం
పండుగలకో, శుభకార్యాలకో
వచ్చే బంధువులమైపోయాం

ఎంత దూరం వెళ్ళినా...
చివరికి మనసు కోరుకునేది ఒక్కటే—
ఒకసారి ఇంటికి వెళ్లాలి...
అమ్మ పిలుపు వినాలి...
నాన్న పక్కన కూర్చోవాలి...
ఏమీ మాట్లాడకుండా
ఆ ఇంట్లోనే కొంతసేపు ఉండాలి.

B. B. Venkata Sai
197030418



A Loving Home

A loving home where hearts belong,

Where every laughter turns to song.

Through stormy days and skies of blue,

We stand together, strong and true.

A gentle word, a warm embrace,

A safe and comforting place to stay.

With shared bright dreams and endless care,

The sweetest love is always there.

B. B. Venkata Sai
VTV30418

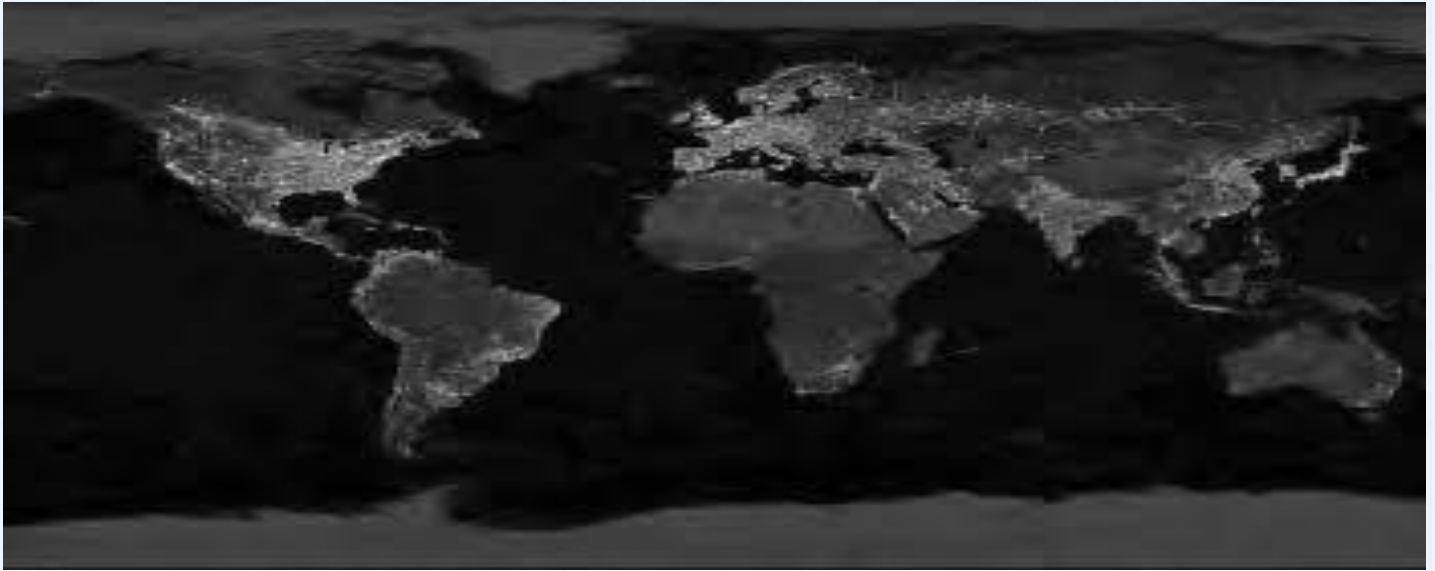
Christian Cooper, a Bird Watcher

EXTRAORDINARY BIRDER WITH CHRISTIAN COOPER

Christian Cooper has since written a memoir, *Better Living Through Birding: Notes from a Black Man in the Natural World*, published by Random House in 2023. In his National Geographic series, *Extraordinary Birder with Christian Cooper*, he explores the relationship between birds, wildlife, and the environments they inhabit, while highlighting innovative approaches to conservation. One such example involves the use of remotely fired lasers to safely disperse large groups of ravens in the California desert. The approach demonstrates how modern technology can be used as a non-lethal tool in wildlife management, helping address ecological challenges while avoiding direct harm to the animals involved.

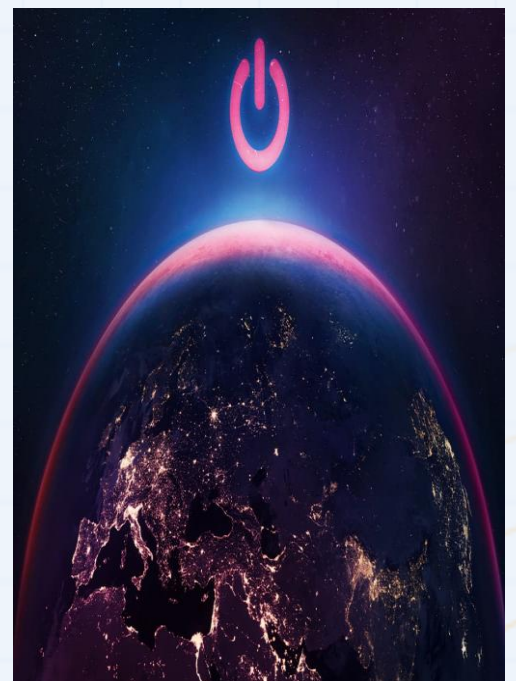
Raven populations have increased in areas affected by human expansion, including regions around Palm Springs, creating concerns for vulnerable desert tortoise hatchlings. Ravens are known to prey on young tortoises, increasing pressure on an already vulnerable population. In the conservation effort featured in the series, Cooper uses VR goggles to direct a non-lethal laser beam toward the ravens. The unexpected light startles the birds and encourages them to leave the area, reducing their presence around the tortoise habitat without physically harming them. This approach illustrates how technology can support conservation by changing animal behaviour in a controlled and non-invasive way, while helping protect vulnerable wildlife and maintain the balance of desert ecosystems.

A Day Without Power



Imagine waking up tomorrow and finding that the lights will not switch on. Your phone is dead, the fan is still, the water pump is silent, and the lift is stuck between floors. As the outage continues, its effects begin to spread beyond individual homes. Trains may slow down, traffic signals can go dark, mobile towers may gradually lose service, and hospitals have to depend on backup generators to keep critical equipment operating. Water supply systems, refrigeration, communication networks, banking services, and other essential facilities are also affected when electrical power is unavailable. Within hours, food and medicines that require controlled temperatures can begin to spoil, while offices, classrooms, shops, and factories may be forced to stop their normal operations. What initially appears to be a simple power failure can therefore become a disruption that touches almost every part of modern life.

A single day without power reveals how deeply society depends on an electrical system that we often take for granted. This is why engineers continuously work to improve the reliability, protection, and resilience of power systems. Protection schemes are designed to detect and isolate faults quickly, helping prevent a local problem from affecting a larger part of the network. Energy storage can support critical loads during outages, while microgrids can help maintain essential electricity services for locations such as campuses, communities, and remote areas. Smart meters and modern monitoring systems can also provide information that helps utilities identify problems and restore supply more efficiently. The next time a light turns on with the simple flick of a switch, spare a thought for the engineers, equipment, control systems, and infrastructure working behind that everyday moment—and for how much of modern life depends on keeping that system running.



Art: Shading Some Real Truth!



VTU21247 Tejaswini

Brain Teaser: Try once!

• I oppose changes in voltage and store energy electrostatically in an electric field. What am I?

Answer: Capacitor

• I oppose the flow of electric current and dissipate electrical energy primarily as heat. What am I?

Answer: Resistor

• I act as a signal amplifier or a solid-state switch in modern electronic circuits. What am I?

Answer: Transistor

• I convert chemical energy directly into electrical energy through electrochemical reactions. What am I?

Answer: Battery

• I protect electrical circuits by melting and breaking the connection when current exceeds a safe limit. What am I?

Answer: Fuse

• I convert alternating current (AC) into direct current (DC). What am I?

Answer: Rectifier

• I convert direct current (DC) into alternating current (AC). What am I?

Answer: Inverter

• I function as an electrically operated switch using an electromagnetic coil to control a separate circuit. What am I?

Answer: Relay

• I am an electromagnetic device that converts mechanical power into electrical power. What am I?

Answer: Generator

• I measure the rate of electrical energy consumption over time in a power system. What am I?

Answer: Energy-meter

Quiz Challenges

•What is the process of adding specific impurities to a pure semiconductor to enhance its electrical conductivity?

A) Rectification B) Doping C) Amplification D) Polarization

Answer: B) Doping

•Which logic gate produces a HIGH output only when all of its inputs are HIGH?

A) OR Gate B) NOR Gate C) AND Gate D) NOT Gate

Answer: C) AND Gate

•What are the three terminals of a standard Bipolar Junction Transistor (BJT)?

A) Source, Drain, Gate B) Anode, Cathode, Gate C) Emitter, Base, Collector D) Primary, Secondary, Core

Answer: C) Emitter, Base, Collector

•What is the ideal input impedance of an Operational Amplifier (Op-Amp)?

A) Zero B) Low C) Moderate D) Infinite

Answer: D) Infinite

•Under which bias condition does a Light Emitting Diode (LED) emit light?

A) Forward-biased B) Reverse-biased C) Unbiased D) Thermal breakdown

Answer: A) Forward-biased

•Which electronic component is commonly placed in parallel across a rectifier output to filter and smooth out voltage ripples?

A) Resistor B) Capacitor C) Inductor D) Transformer

Answer: B) Capacitor

•In digital electronics, what is the decimal equivalent of the binary number 1101?

A) 11 B) 12 C) 13 D) 15

Answer: C) 13

TTS3550 Dr. R.A. Priya

◆ CREDITS

Editorial Team & Acknowledgements**ACKNOWLEDGEMENTS**

The editorial team thanks the management of Vel Tech University for their constant encouragement, the Head of the Department for guidance, the faculty members who contributed articles and students who shared their contents.

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