AY-2023-2024

# SPARK ERA

## Technical Magazine from

DEPARTMENT OF

## ELECTRICAL & ELECTRONICS ENGINEERING





GATES

INSTITUTE OF TECHNOLOGY

**Autonomous**

**Approved by A.I.C.T.E. & Affiliated to JNTUA, Ananthapuramu, Gootyanantapur(v), Gooty, Ananthapuramu(Dist.)-515401**

NBA ACCREDITED · NAAC 'A' GRADE

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EDITORIAL TEAM

## Spark Era · Annual Technical Magazine

| | |
|---|---|
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ABOUT THE NAME

A spark is where every electrical idea begins — the first flash of current, the first switching edge, the first idea in a student's mind. Spark Era celebrates a year in which the department lit many such sparks, and a decade in which electrical engineering is reshaping how the world makes and uses energy.

MESSAGE

# From the HoD's Desk

*Dear Students, Faculty Members and Well-wishers,*

It is a matter of great pride to present Spark Era, the annual technical magazine of the Department of Electrical & Electronics Engineering, for the Academic Year 2023–24.

Over the year, the department organised 13 programmes with more than 910 student participations. Two certification courses — on Smart Grid and on Electric Vehicle Technology — gave students skills that the power and e-mobility industries are actively seeking. Training on ICT tools, sessions on power semiconductors, control techniques, machine modelling and energy utilization, and field exposure at a substation connected classroom theory with professional practice.

Equal care went into the whole engineer: soft-skills, communication and life-skills workshops, guidance on GATE and IES, and a seminar on identifying research problems. Every activity was planned in line with the Vision and Mission of the Institute and the Department.

This edition also carries a special section on the latest technologies and trends in electrical engineering during 2023–24 — a record year for renewable energy in India, the launch of rooftop-solar and battery-storage schemes, rapid growth of electric vehicles, and the beginning of India's semiconductor manufacturing journey. I hope these pages help our students see where their subjects lead and inspire them to prepare for the opportunities ahead.

I congratulate our students on their enthusiasm and thank the faculty coordinators and invited resource persons who made each programme a meaningful learning experience. I wish every reader continued growth and success.

*With best wishes,*

**Dr. N. Narasimhulu**

Head of the Department, EEE · GATES Institute of Technology, Gooty





*Moments from the department's programmes, 2023–24*

WHO WE ARE

# About GATES and the Department of EEE

GATES Institute of Technology, Gooty, is an autonomous institution approved by AICTE and affiliated to JNTUA, Ananthapuramu. Accredited by NBA and with an 'A' grade from NAAC, the Institute serves the drought-prone rural region of Anantapur district by offering professional education with discipline, values and a strong practical orientation. Its green campus, powered in part by solar energy, reflects the Institute's commitment to sustainability.

The Department of Electrical & Electronics Engineering offers the B.Tech programme in EEE with well-equipped laboratories in electrical machines, power electronics, power systems, control systems, measurements and simulation. Faculty and students take part in workshops, certification courses, industrial visits and guest lectures, so that classroom learning is linked with the technologies used in industry today.

## The Institute

### VISION

*To impart the best technical and management education instilled with discipline, values and leadership qualities that will produce professional technocrats.*

### MISSION

**M1** To contribute to the social and economic development of this drought prone rural region through professional education.

**M2** To prepare graduates who will engage effectively and responsibly in practicing of engineering and management profession in ever changing global economy.

**M3** To contribute and to be a role model for a green and eco-friendly campus through solar energy.

## Department of EEE

### VISION

*To impart the best technical education instilled with discipline, values and leadership qualities that will produce professional technocrats in Electrical and Electronics Engineering.*

### MISSION

**M1** To impart fundamental Electrical and Electronics Engineering concepts and a broad set of technical skills.

**M2** To prepare Electrical and Electronics Engineering graduates who will engage effectively and responsibly in practicing engineering.

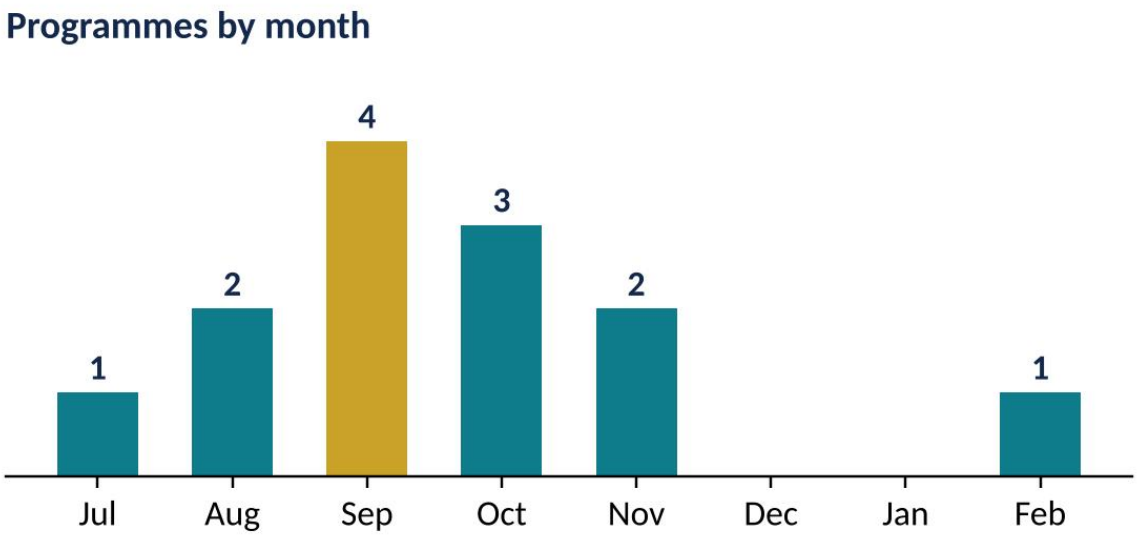
**M3** To impart practical exposure on latest technological developments in Electrical and Electronics Engineering.

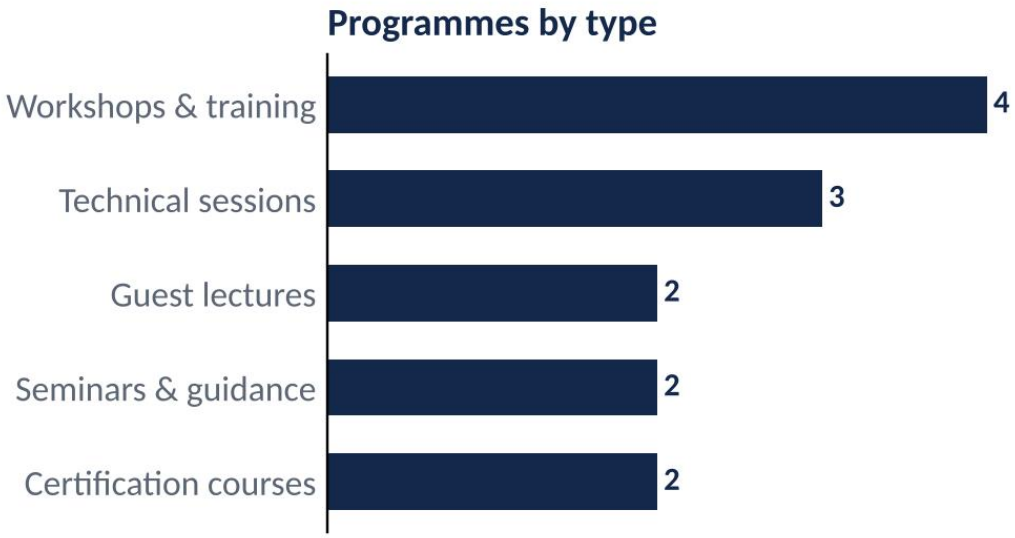
2023–24 AT A GLANCE

# The Year in Numbers

| 13 | 910 | 125 | 2 |
|---|---|---|---|
| PROGRAMMES ORGANISED | STUDENT PARTICIPATIONS | IN THE LARGEST PROGRAMME | CERTIFICATION COURSES |

The academic year began in July 2023 with a technical session on power semiconductor switches and closed in February 2024 with a life-skills workshop. September was the busiest month, with the Smart Grid certification course, a three-day soft-skills workshop, a guest lecture on machine modelling and field exposure at a substation. The charts below show how the programmes were spread across the year and across different types of learning.



ACTIVITY REGISTER

# Summary of Department Activities

*Every programme organised by the Department of EEE during AY 2023–24, in chronological order.*

| No. | Date | Programme | Type | Students |
|---|---|---|---|---|
| 1 | 03 Jul 2023 | **Advanced Power Semiconductor Switches** | Technical Session | 65 |
| 2 | 18 Aug 2023 | **Guest Lecture on Advanced Control Techniques** | Guest Lecture | 64 |
| 3 | 28 Aug 2023 | **How to Identify a Problem in Research** | Seminar | 86 |
| 4 | 11 – 16 Sep 2023 | **Six-Day Workshop & Certification Course on Smart Grid** | Workshop & Certification | 125 |
| 5 | 25 – 27 Sep 2023 | **Three-Day Workshop on Soft Skills** | Workshop | 122 |
| 6 | 26 Sep 2023 | **Guest Lecture on Machine Modelling** | Guest Lecture | 58 |
| 7 | 30 Sep 2023 | **Operation and Maintenance of Sub-station** | Technical Session & Field Exposure | 66 |
| 8 | 14 Oct 2023 | **Workshop on Communication Skills** | Workshop | 65 |
| 9 | From 14 Oct 2023 | **Six-Day Certification Course on Electric Vehicle Technology** | Certification Course | — |
| 10 | 26 Oct 2023 | **Awareness Programme on GATE & IES (ESE)** | Career Guidance | 64 |
| 11 | 06 Nov 2023 | **Training on ICT Tools for Engineers** | Training | 64 |
| 12 | 22 Nov 2023 | **Utilization of Electrical Energy** | Academic Session | 66 |
| 13 | 16 Feb 2024 | **Life Skills** | Workshop | 65 |
| | | | **Total student participations** | **910** |

HIGHLIGHT OF THE YEAR

## Six-Day Workshop & Certification Course on Smart Grid

125 students — the largest participation of the year — studied smart-grid architecture, AMI, demand response, renewable integration and SCADA, and earned course-completion certificates.

FEATURE STORY · WORKSHOP & CERTIFICATION

# Six-Day Workshop & Certification Course on Smart Grid

**11 – 16 September 2023 • 125 students • Flagship programme**





*Exposure to control and monitoring panels, and a technical session*

The flagship programme of the year drew the largest participation, with 125 students. Over six days, participants studied smart grid architecture, advanced metering infrastructure, demand-side management and demand response, and the integration of solar and wind energy into the grid. Sessions on SCADA-based monitoring, power quality and cyber security in energy networks showed how utilities run a modern grid.

Each day combined lectures with discussion, so that students could relate new ideas to the Power Systems, Power Electronics and Control Systems subjects they study in class. The course also explained how smart meters, sensors and communication networks work together to give utilities real-time information about the grid, and how these technologies support India’s plans for renewable energy and smart cities.

Structured assessments and practical exercises at the end of the course led to a course-completion certificate for each participant.

**WHAT STUDENTS GAINED**

Students understood how conventional power delivery is becoming an intelligent, two-way network, and earned a certificate that strengthens their profile for careers in the power sector and smart-city projects.

FEATURE STORY · CERTIFICATION COURSE

# Six-Day Certification Course on Electric Vehicle Technology

**From 14 October 2023 • Six-day certification**




*Participants during a practical session*

This six-day certification course gave students a structured introduction to one of the fastest-growing areas of electrical engineering. It began with EV types and architecture (BEV, HEV, PHEV and FCEV) and moved on to lithium-ion and solid-state batteries and battery management systems. Students then studied the power electronics of an EV — traction inverters, DC-DC converters and on-board chargers — along with BLDC, PMSM and induction motor drives and regenerative braking.

The course closed with charging standards such as CHAdeMO, CCS and Bharat AC/DC, and India's EV policy, including FAME-II and the PLI scheme. Throughout, the content was linked to the Power Electronics, Electrical Machines and Control Systems subjects of the B.Tech EEE programme, and students discussed how EVs connect with renewable energy and the smart grid.

**WHAT STUDENTS GAINED**

Participants earned a certificate and industry-relevant knowledge for careers in EV manufacturing, battery technology and charging infrastructure.

# Month by Month

## 01 Advanced Power Semiconductor Switches

03 Jul 2023 • Technical Session • 65 students

This technical session introduced students to the switching devices at the heart of modern power electronics. The resource person explained the characteristics, gate-drive requirements, switching behaviour and thermal management of IGBTs and power MOSFETs, and then moved on to wide-bandgap devices such as SiC MOSFETs and GaN transistors. Students compared how each device performs in inverters, DC-DC converters and motor drives, and discussed why the industry is shifting towards faster, more efficient switches. Examples from solar inverters, UPS systems and electric-vehicle drives showed students where each device is used today.

**Outcome:** Students can compare power devices on switching speed, losses and thermal limits, and select a suitable device for a given converter application.



*Hands-on practice during the session*

## 02 Guest Lecture on Advanced Control Techniques

18 Aug 2023 • Guest Lecture • 64 students

An invited expert took students beyond the classical controllers of the undergraduate syllabus. The lecture covered model predictive control, fuzzy logic control, sliding mode control and adaptive control, explaining the idea behind each method and where it is used. Practical examples from power electronic converters, motor drives and process automation showed how these controllers improve speed of response, stability and efficiency. The speaker compared each technique with the familiar PID controller, using simple block diagrams and response curves rather than heavy mathematics.

**Outcome:** Students gained a working picture of modern controller design and its role in high-performance EEE applications.



*Students at the guest lecture*

## 03 How to Identify a Problem in Research

28 Aug 2023 • Seminar • 86 students

This seminar helped students take their first steps in research. It explained how to carry out a focused literature review, spot gaps in existing work, and turn a broad interest into a clear research question and problem statement. Students were shown how to search IEEE Xplore, Scopus and Google Scholar effectively and how to read papers critically, so that their mini and major projects begin with a well-defined problem. The session also covered choosing a topic that is practical within a B.Tech project and keeping proper references from day one.

**Outcome:** Students learned a structured method for literature survey and problem definition for their projects.




*Seminar in progress*

## 05 Three-Day Workshop on Soft Skills

25 – 27 Sep 2023 • Workshop • 122 students

This three-day workshop focused on the personal and professional skills that employers look for alongside technical knowledge. Sessions covered communication, résumé preparation, professional etiquette, teamwork and leadership, conflict resolution and time management. Students practised interviews and group discussions through role-plays and mock GDs, receiving feedback at each stage. The three-day format allowed skills to be built step by step, and short team tasks let students practise leadership, listening and cooperation in a real setting.

**Outcome:** Students built confidence and readiness for campus placements, interviews and team-based project work.



*Session on résumé preparation*

## 06 Guest Lecture on Machine Modelling

26 Sep 2023 • Guest Lecture • 58 students

An invited expert explained how electrical machines are represented mathematically for analysis and control. The lecture covered Park's (d-q) transformation, space-phasor theory and reference-frame theory, followed by steady-state and dynamic models of DC, induction, synchronous and permanent-magnet machines. A demonstration of machine simulation in MATLAB/Simulink, with examples from wind generators and electric vehicles, connected the theory to modern drive design and showed how simulation lets engineers test a design safely before building hardware.

**Outcome:** Students extended their Electrical Machines knowledge into dynamic modelling and simulation.



*Students at the guest lecture*

## 07 Operation and Maintenance of Sub-station

30 Sep 2023 • Technical Session & Field Exposure • 66 students

This session gave students field exposure to high-tension and extra-high-voltage substations. They studied the layout of a substation and the role of each item of equipment — power transformers, bus bars, isolators, circuit breakers, CTs, PTs and relay panels. Engineers explained preventive maintenance schedules, earth-fault protection, condition monitoring and the strict safety procedures followed near high voltage, and how faults are detected and isolated so that supply is restored quickly.

**Outcome:** Students related Switchgear & Protection and Power Systems theory to real utility practice and its safety requirements.



*Students with faculty at the substation*

## 08 Workshop on Communication Skills

14 Oct 2023 • Workshop • 65 students

This one-day workshop helped students present technical ideas clearly and professionally. Topics included preparing and delivering technical presentations, writing professional e-mails and reports, writing an effective résumé, active listening and body language. Students took part in role-plays, short presentations and group discussions, and received peer feedback. Special attention was given to explaining technical topics in simple language — an essential skill for project reviews, seminars and interviews.

**Outcome:** Students improved their written and spoken communication for academic, placement and workplace settings.



*Interactive session with students*

## 10 Awareness Programme on GATE & IES (ESE)

26 Oct 2023 • Career Guidance • 64 students

This career-guidance programme introduced students to the GATE and IES/ESE examinations. The speaker explained the exam pattern, how the syllabus maps to the B.Tech EEE curriculum, and a subject-wise preparation plan with recommended books and online resources. Students learned how GATE scores open the way to M.Tech admissions and PSU recruitment, and how a career in the central engineering services progresses. Practical advice on study timetables, previous papers and mock tests encouraged them to start early.

**Outcome:** Students received a clear roadmap and motivation for higher studies and public-sector careers.



*Resource person addressing students*

## 11 Training on ICT Tools for Engineers

06 Nov 2023 • Training • 64 students

Held in the computer laboratory, this training built practical digital skills for engineering study and work. Students were introduced to MATLAB/Simulink, ETAP and AutoCAD Electrical for analysis and design, Google Workspace and Microsoft 365 for collaboration, and LaTeX and Word for reports. The session also covered digital libraries such as IEEE Xplore, Scopus and NDLI, and online learning through NPTEL, SWAYAM and Coursera. Students practised on the systems throughout, which made the training hands-on.

**Outcome:** Students can use digital tools confidently for projects, research and technical reporting.



*Students at work in the computer laboratory*

## 12 Utilization of Electrical Energy

22 Nov 2023 • Academic Session • 66 students

This session showed how electrical energy is used efficiently in homes, offices and industry. It covered illumination design using the lumen method, electric heating and welding, and electric traction in railways and metro systems. The second half dealt with energy audits, power-factor improvement and demand-side management. Real examples — replacing old lamps with LED lighting and correcting low power factor in industries — showed how simple measures bring large savings, in keeping with the Institute's green-campus mission.

**Outcome:** Students connected course theory with real applications and the importance of energy conservation.



*Students during the session*

## 13 Life Skills

16 Feb 2024 • Workshop • 65 students

This workshop focused on the personal skills that support success in study, work and life. Students explored self-awareness and managing emotions, making sound decisions, solving problems, building good relationships through empathy, and coping with stress and setbacks. Group activities, short reflections and case discussions helped them apply these ideas to situations they face in college and will face at work, and encouraged them to set personal goals and balance studies with personal life.

**Outcome:** Students gained practical tools for handling the personal and professional challenges of an engineering career.



*Workshop session*

LOOKING BACK

### A balanced calendar

The year's programmes combined deep technical learning — power semiconductors, control, machine modelling, smart grids and electric vehicles — with the personal and professional skills employers value. Field exposure at a substation and training in digital tools connected the classroom with the workplace, while guidance on GATE, IES and research helped students plan their next steps.

SPECIAL SECTION

# Latest Technologies & Trends in Electrical Engineering

*Academic Year 2023 – 24*

The twelve months from July 2023 to June 2024 were among the most eventful in the history of electrical engineering in India. The country added a record amount of renewable capacity, launched national schemes for rooftop solar, battery storage and offshore wind, approved its first commercial semiconductor fab, and saw electric-vehicle sales cross 16 lakh. At the same time, electricity demand reached new peaks and artificial intelligence entered almost every field of engineering.

This special section explains eleven of these developments in simple language. Each article gives the key numbers, explains the technology from an electrical engineer's point of view, links it to subjects in the B.Tech EEE curriculum, and ends with a takeaway for students. Facts and figures are taken from official government releases and reputed news sources, which are named at the foot of each page.


**01** A record year for clean power
RENEWABLE ENERGY

**02** Rooftop solar comes home
DISTRIBUTED SOLAR

**03** Storing sunshine for the evening peak
ENERGY STORAGE

**04** The year India went electric
ELECTRIC MOBILITY

**05** Wide-bandgap devices: SiC and GaN
POWER ELECTRONICS

**06** India builds its chip ecosystem
SEMICONDUCTORS

**07** AI enters the control room
ARTIFICIAL INTELLIGENCE

**08** The grid gets intelligent
SMART GRIDS

**09** Record demand, reliable supply
GRID RESILIENCE

**10** Electricity becomes a fuel
GREEN HYDROGEN

**11** Wind power heads out to sea
OFFSHORE WIND

TREND 01 · RENEWABLE ENERGY

# A record year for clean power

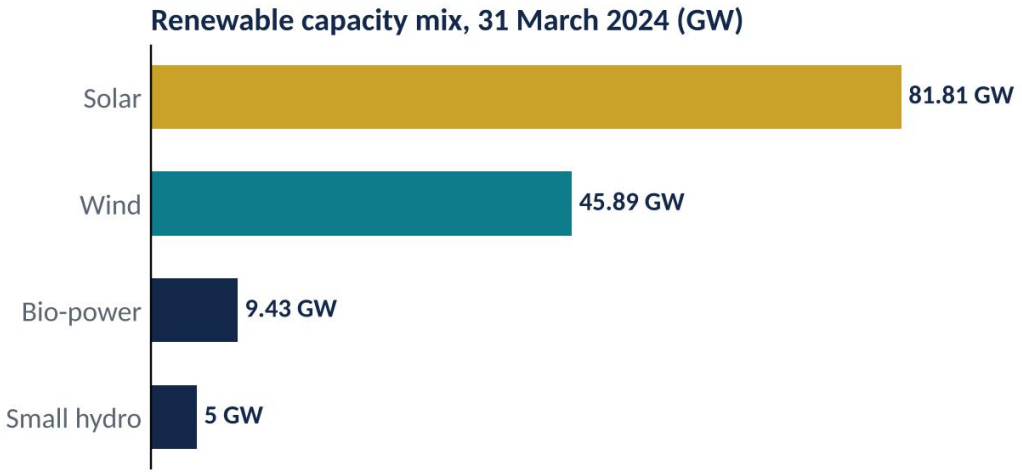
*India added more renewable capacity in 2023-24 than in any year before — and solar led the way.*

| 18.48 GW | 143.64 GW | 81.81 GW |
|---|---|---|
| Renewable capacity added in FY 2023-24 | Installed RE capacity, 31 Mar 2024 (excl. large hydro) | Solar capacity, the largest share |

The academic year 2023-24 coincided with the biggest annual jump in India's renewable energy capacity so far. Solar parks in Rajasthan and Gujarat, wind farms in Tamil Nadu and Karnataka, and hybrid projects that combine both on one site all came on line at a faster pace than ever.

For electrical engineers this is not just an environmental story. Every new solar park needs inverters, transformers, protection schemes and transmission lines; every wind farm needs grid-code compliance, reactive-power support and careful forecasting. As the share of variable sources rises, keeping voltage and frequency stable becomes a central engineering task.

Andhra Pradesh — our own state — is among the leaders, with around 11 GW of renewable capacity. The jobs of the future in operation, maintenance, design and grid integration of these plants will need exactly the power-systems and power-electronics foundation that our curriculum provides.




*Solar has overtaken wind as the largest renewable source in India.*

FOR EEE STUDENTS **Learn PV system design, inverter control and grid integration — the core skills of the renewable sector.**

LINKED SUBJECTS

**Power Systems · Power Electronics · Renewable Energy Sources**

DID YOU KNOW?

A solar cell converts only about a fifth of the sunlight falling on it into electricity — yet solar is now India's largest renewable source.

*Sources: MNRE data reported by PTI (14 Apr 2024); MNRE FY 2024-25 press release (PIB, 10 Apr 2025) for wind and solar capacity.*

TREND 02 · DISTRIBUTED SOLAR

# Rooftop solar comes home

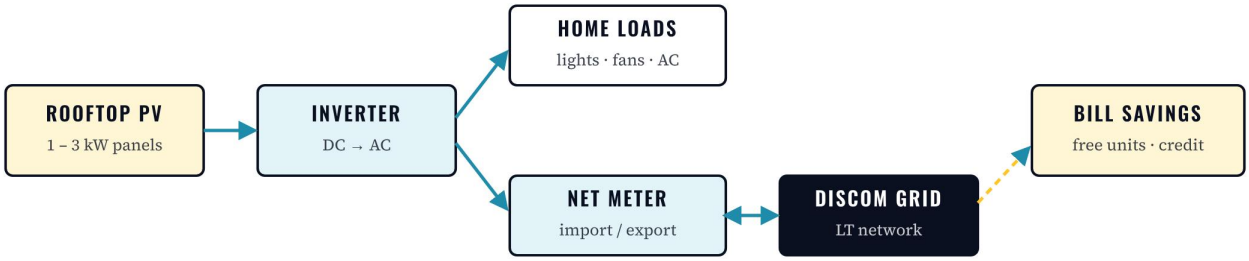
*A national scheme launched in February 2024 aims to put solar panels on one crore rooftops.*

| ₹75,021 cr | 1 crore | 300 units |
|---|---|---|
| Outlay of PM Surya Ghar: Muft Bijli Yojana | Households targeted for rooftop solar | Free electricity per month for each household |

On 13 February 2024 the Prime Minister launched PM-Surya Ghar: Muft Bijli Yojana, and the Union Cabinet approved it on 29 February. The scheme gives central financial assistance for residential rooftop solar — about ₹30,000 for a 1 kW system, ₹60,000 for 2 kW and ₹78,000 for systems of 3 kW or more — and families can apply through a national portal.

Millions of small rooftop plants change how the distribution network behaves. Power now flows from the consumer back to the grid at noon, so voltage regulation, net metering, protection settings and transformer loading all have to be re-examined. Distribution engineers must plan for a two-way network.

The scheme also creates work close to home: site surveys, system sizing, installation, wiring, earthing, net-meter commissioning and after-sales maintenance. A model solar village is planned in every district, bringing these opportunities to rural areas like ours.




*A grid-connected rooftop system: surplus solar is exported through the net meter.*

FOR EEE STUDENTS **Rooftop solar design, net metering and LT distribution practice are directly employable skills.**

LINKED SUBJECTS

**Electrical Distribution · Utilization of Electrical Energy**

DID YOU KNOW?

A 1 kW rooftop system in a sunny region generates roughly 4 units of electricity a day.

*Source: Cabinet approval of PM-Surya Ghar: Muft Bijli Yojana (pmindia.gov.in, 29 Feb 2024).*

TREND 03 · ENERGY STORAGE

# Storing sunshine for the evening peak

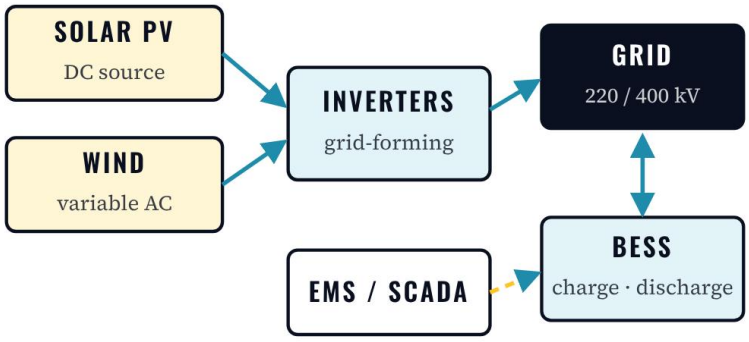
*Battery energy storage moved from pilot projects to national policy in 2023-24.*

| 4,000 MWh | ₹3,760 cr | Up to 40% |
|---|---|---|
| BESS capacity to be supported by 2030-31 | Viability gap funding approved, Sept 2023 | Of capital cost covered by the VGF |

Solar output peaks at noon but demand peaks after sunset. Battery energy storage systems (BESS) solve this mismatch by charging when power is plentiful and discharging when it is scarce. On 6 September 2023 the Union Cabinet approved a Viability Gap Funding scheme to make such projects financially viable.

A grid-scale BESS is an electrical engineer's system: thousands of lithium-ion cells managed by a battery-management system, bidirectional power-conversion systems, step-up transformers, protection and SCADA control. Batteries can also provide fast frequency response — reacting in milliseconds to keep the grid stable when a large generator trips.

Storage is the key that will let renewable energy supply power round the clock, and it links directly to the battery technology our students met in the EV certification course.




*Renewables, inverters and battery storage working together under an energy-management system.*

**FOR EEE STUDENTS** **Battery sizing, power-conversion systems and BMS design are fast-growing specialisations.**

**LINKED SUBJECTS**

**Power Electronics · Electrical Measurements · Power Systems**

**DID YOU KNOW?**

A grid battery can change from full charging to full discharging in well under a second — far faster than any thermal power plant.

*Source: Union Cabinet approval of VGF scheme for BESS, 6 Sept 2023 (as reported by PTI and YourStory).*

TREND 04 · ELECTRIC MOBILITY

# The year India went electric

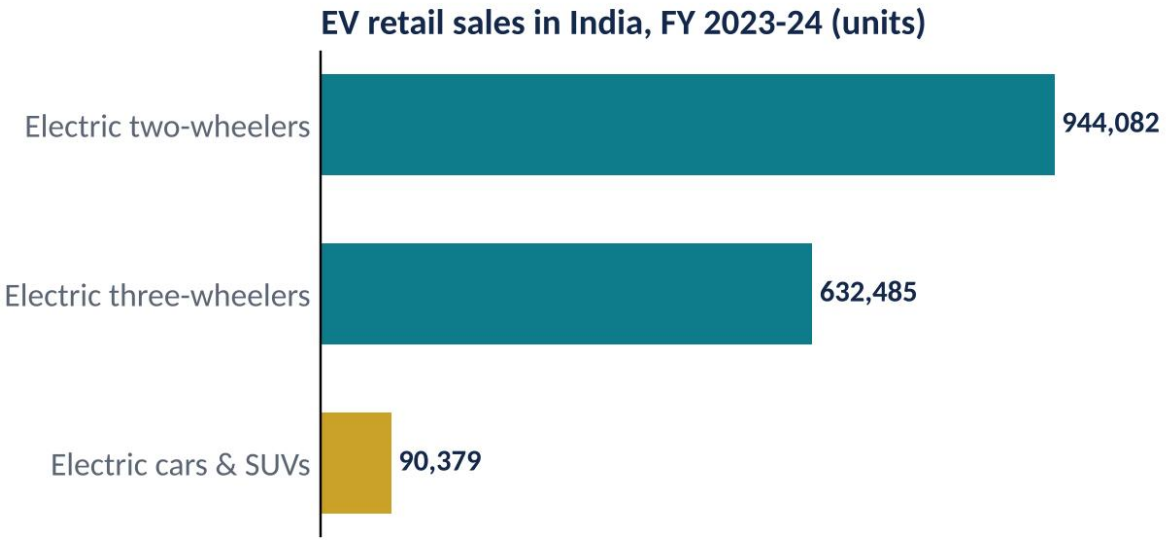
*More than 16 lakh electric vehicles were sold in 2023-24 — led by two- and three-wheelers.*

| 16.75 lakh | 42% | 4,591 |
|---|---|---|
| EVs retailed in FY 2023-24 (Vahan) | Growth over the previous year | EVs sold every day, on average |

Electric vehicles moved firmly into the mainstream during 2023-24. Electric scooters and e-rickshaws dominate the numbers, but electric car and SUV sales also nearly doubled. Every one of these vehicles is, at heart, a power-electronics system on wheels.

An EV combines a lithium-ion battery pack, a battery-management system, a traction inverter, a motor (usually PMSM or BLDC), regenerative braking and an on-board charger. Each of these is a subject in the B.Tech EEE syllabus — and each is now a product that Indian companies design and manufacture.

The growth also creates new challenges for the grid: charging stations are new, concentrated loads, and the industry is moving towards smart charging and vehicle-to-grid (V2G) technologies. The six-day EV certification course run by our department this year was timed perfectly for this wave.




*Two- and three-wheelers made up the bulk of EV sales in FY 2023-24.*

FOR EEE STUDENTS **Motor drives, converter design and battery management are the core skills of the EV industry.**

LINKED SUBJECTS

**Electrical Machines · Power Electronics · Control Systems**

DID YOU KNOW?

Regenerative braking turns the traction motor into a generator, returning energy to the battery every time the vehicle slows down.

*Source: Vahan retail data as analysed by Autocar Professional (April 2024).*

TREND 05 · POWER ELECTRONICS

# Wide-bandgap devices: SiC and GaN

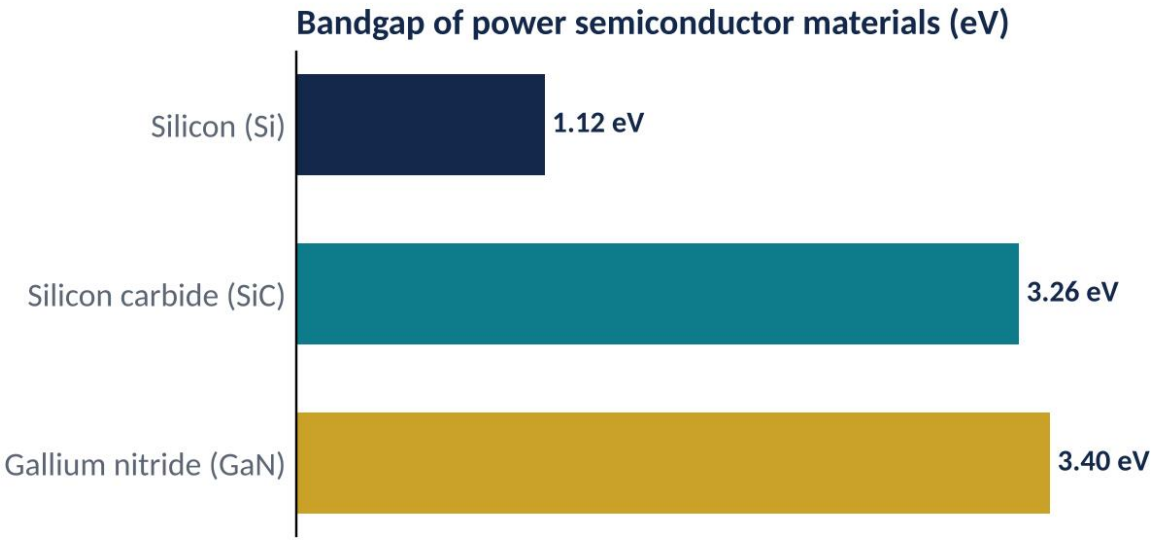
*New semiconductor materials are making converters smaller, faster and more efficient.*

| ~3× | Higher | Lower |
|---|---|---|
| Wider bandgap of SiC and GaN compared with silicon | Switching frequency → smaller magnetics | Losses → smaller heat sinks |

For decades the silicon IGBT and MOSFET were the workhorses of power electronics. Silicon carbide (SiC) and gallium nitride (GaN) have a much wider bandgap, which lets them block higher voltages, switch much faster and operate at higher temperatures with lower losses.

The practical result is striking: EV traction inverters with higher efficiency and longer driving range, fast chargers that fit in a small cabinet, laptop and phone chargers half the size of older designs, and solar inverters with lower cooling needs. Many EV makers are now moving to 800 V battery systems built around SiC devices.

Using these devices well needs new skills — fast gate drivers, careful PCB layout to reduce parasitic inductance, EMI filtering and thermal design. Our technical session on advanced power semiconductor switches in July 2023 introduced students to exactly these ideas.




*A wider bandgap allows higher voltage, temperature and switching speed.*

FOR EEE STUDENTS **Converter design with SiC/GaN, gate drivers and thermal management are high-value design skills.**

LINKED SUBJECTS

**Power Electronics · Electronic Devices & Circuits**

DID YOU KNOW?

Small GaN chargers are possible because faster switching allows much smaller transformers and capacitors.

*Bandgap values: standard material data (Si 1.12 eV, 4H-SiC 3.26 eV, GaN 3.4 eV at room temperature).*

TREND 06 · SEMICONDUCTORS

# India builds its chip ecosystem

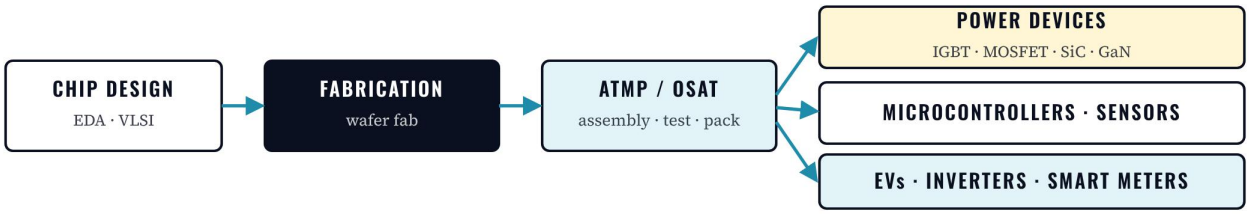
*In February 2024 the Union Cabinet approved India's first commercial semiconductor fab.*

| ₹1.26 lakh cr | ₹91,000 cr | 50,000 |
|---|---|---|
| Investment in three semiconductor units approved | Tata–PSMC fab at Dholera, Gujarat | Wafer starts per month planned at the fab |

On 29 February 2024 the Union Cabinet approved three semiconductor units under the India Semiconductor Mission: a fab at Dholera by Tata Electronics with Taiwan's Powerchip Semiconductor Manufacturing Corporation, and assembly-and-test units at Morigaon in Assam and Sanand in Gujarat. All three were to begin construction within 100 days.

Semiconductors are the building blocks of everything an electrical engineer designs today — power devices for inverters and drives, microcontrollers for control, sensors for measurement and the chips inside smart meters and EVs. A domestic chip industry means supply security and a large number of new jobs.

EEE graduates have a place in this industry: power-device testing, fab facility electrical systems (which need extremely reliable power), equipment maintenance, and design of power-management ICs. Knowledge of electronics, VLSI basics and power electronics is the entry ticket.




*The semiconductor value chain — and where power devices fit.*

FOR EEE STUDENTS **Device physics, VLSI basics and power-device testing open doors in a brand-new Indian industry.**

LINKED SUBJECTS

**Electronic Devices · Digital Electronics · VLSI Design**

DID YOU KNOW?

A modern chip fab needs an extremely reliable power supply — even a voltage dip lasting a fraction of a second can spoil wafers in production.

*Source: PIB / Ministry of Electronics & IT, Cabinet approval of three semiconductor units (29 Feb 2024).*

TREND 07 · ARTIFICIAL INTELLIGENCE

# AI enters the control room

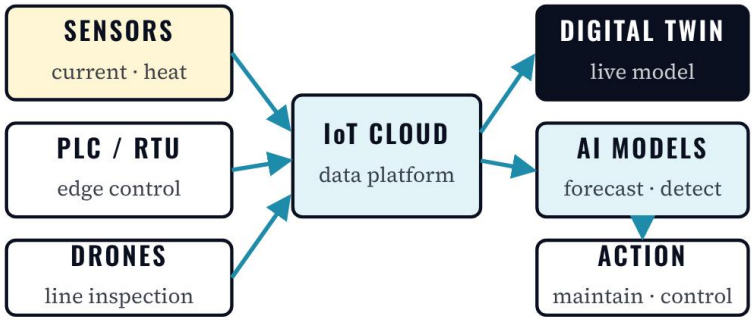
*Generative AI captured the world's attention in 2023 — and power engineering is putting it to work.*

| ₹10,371.92 cr | 10,000+ | 5 years |
|---|---|---|
| Outlay of the IndiaAI Mission, approved Mar 2024 | GPUs planned for public AI compute | Duration of the Mission |

The year 2023-24 will be remembered as the year generative AI went mainstream. In March 2024 the Union Cabinet approved the IndiaAI Mission to build national computing capacity, datasets, skills and start-ups in artificial intelligence.

In electrical engineering, machine learning is already doing practical jobs: forecasting load and solar output, detecting faults from waveform data, predicting transformer and motor failures from temperature and vibration, and optimising the charging of EV fleets. A digital twin — a live simulation kept in step with real equipment — lets operators test a change safely before touching the plant.

Interestingly, AI also creates demand for electrical engineers: large data centres need huge amounts of reliable power, efficient UPS systems and cooling. The ICT tools training held in November 2023 was a first step towards these digital skills.




*From sensor to decision: the data loop behind predictive maintenance.*

FOR EEE STUDENTS **Python, data analysis and basic machine learning are becoming everyday tools for power engineers.**

LINKED SUBJECTS

**Control Systems · Microprocessors · Computer Programming**

DID YOU KNOW?

Data centres that run AI models are among the fastest-growing electrical loads in the world.

*Source: PIB, Cabinet approval of the IndiaAI Mission (7 Mar 2024).*

TREND 08 · SMART GRIDS

# The grid gets intelligent

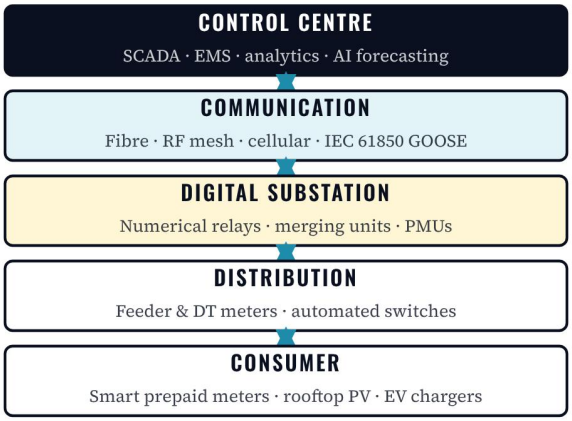
*Smart meters, digital substations and real-time monitoring are turning a one-way network into a two-way system.*

| Two-way | IEC 61850 | Real-time |
|---|---|---|
| Power and data now flow in both directions | Standard for digital substation communication | Monitoring with PMUs and SCADA |

The traditional grid sent power in one direction — from large generators to passive consumers — with meters read once a month. The smart grid adds sensors, communication and control at every level. Smart prepaid meters give consumers and utilities real-time data, distribution automation isolates faults within seconds, and phasor measurement units (PMUs) let operators watch the grid's dynamics many times a second.

Inside substations, copper wiring between instrument transformers and relays is giving way to optical fibre and the IEC 61850 standard. Merging units digitise currents and voltages at the switchyard, and numerical relays exchange protection messages in milliseconds.

Our six-day Smart Grid certification course in September 2023 — the flagship programme of the year — covered exactly these technologies, along with demand response and the growing need for cyber security in energy networks.




*Layers of a smart grid — from the consumer's meter to the control centre.*

FOR EEE STUDENTS **Protection, SCADA, communication protocols and cyber security are the new core of grid engineering.**

LINKED SUBJECTS

**Switchgear & Protection · Power Systems · Communication**

DID YOU KNOW?

A phasor measurement unit time-stamps each measurement using GPS, so readings from distant substations can be compared exactly.

*Technology overview; see the department's Smart Grid certification course (11–16 Sep 2023).*

TREND 09 · GRID RESILIENCE

# Record demand, reliable supply

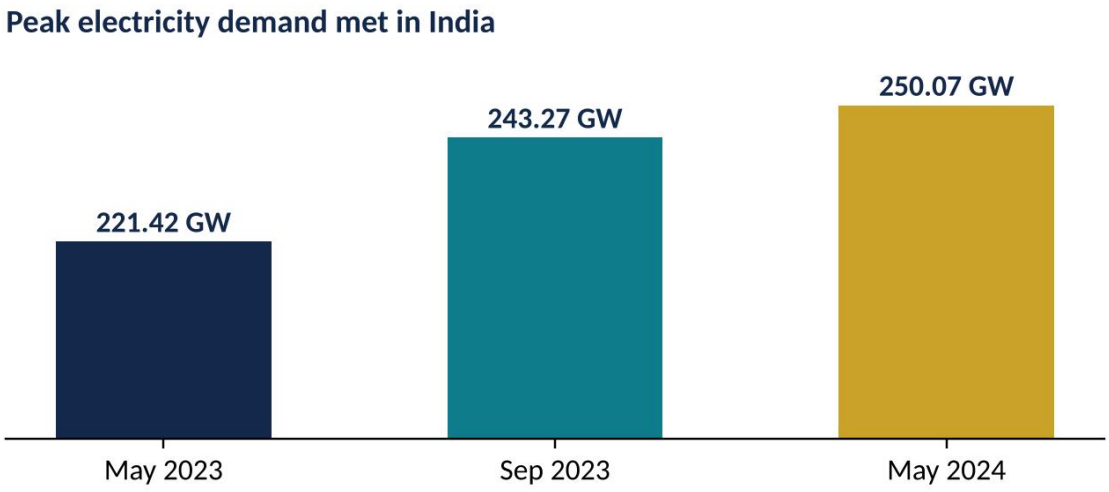
*India's electricity demand broke records twice during the academic year.*

| 243.27 GW | 250 GW | 176 GW |
|---|---|---|
| All-time peak in September 2023 | New record met on 30 May 2024 | Peak thermal generation during non-solar hours |

A growing economy, more air-conditioners and fans, and severe summer heat pushed India's peak electricity demand to new highs. A peak of 243.27 GW was recorded in September 2023, and on 30 May 2024 the country met a record demand of 250 GW.

Meeting such peaks needs careful planning: accurate demand forecasting, scheduling of thermal, hydro, gas and renewable generation, strong inter-regional transmission and quick action when a unit trips. The evening hours — when solar output disappears but cooling load remains high — are the hardest, which is why storage and flexible generation matter so much.

Grid operators in national and regional load-dispatch centres, together with engineers in power plants and substations, made sure the lights stayed on. Their work is a reminder that power systems engineering remains one of the most important professions in the country.




*Peak demand met: rising year after year.*

FOR EEE STUDENTS **Load forecasting, power-system operation and protection skills are always in demand.**

LINKED SUBJECTS

**Power System Operation & Control · Power System Analysis**

DID YOU KNOW?

India runs one of the largest synchronous grids in the world — all regions operate at the same 50 Hz frequency.

*Sources: Ministry of Power data as reported by PTI/Deccan Herald (2 Jun 2024) and Energetica India (31 May 2024).*

TREND 10 · GREEN HYDROGEN

# Electricity becomes a fuel

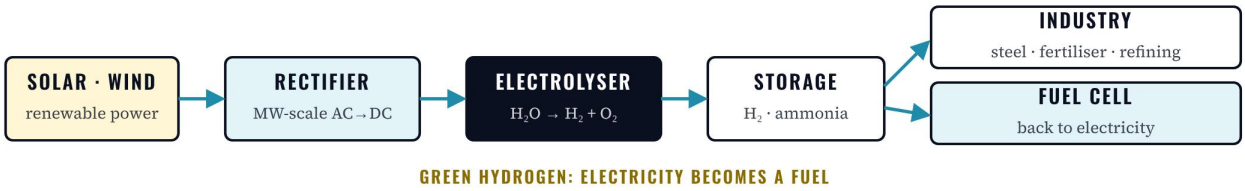
*Green hydrogen, made with renewable power, is India's answer for industries that are hard to electrify.*

| 5 MMT | ₹19,744 cr | ~125 GW |
|---|---|---|
| Green hydrogen per year targeted by 2030 | Initial outlay of the National Green Hydrogen Mission | Associated renewable capacity expected |

Steel, fertilisers, refining and long-distance shipping cannot easily run on electricity directly. Green hydrogen — produced by splitting water in an electrolyser powered by solar and wind — offers them a clean fuel. India's National Green Hydrogen Mission, approved in January 2023, rolled out its incentive schemes for electrolyser manufacturing and hydrogen production during 2023-24.

Seen through an electrical engineer's eyes, an electrolyser plant is a megawatt-scale DC load. Large rectifiers must deliver controlled DC current with low harmonics and high efficiency, while the plant follows the ups and downs of renewable supply. Power quality, protection and control are central to the design.

Each tonne of green hydrogen also needs a large amount of new renewable capacity, which means more solar and wind plants, more transmission and more jobs for power engineers.




*From sunlight to fuel: an electrolyser is a very large DC load fed by power electronics.*

FOR EEE STUDENTS **High-power rectifiers, power quality and renewable integration are the electrical side of hydrogen.**

LINKED SUBJECTS

**Power Electronics · Electrical Machines · Chemistry**

DID YOU KNOW?

Producing one kilogram of hydrogen by electrolysis needs roughly 50 units of electricity.

*Source: PIB / MNRE, National Green Hydrogen Mission (outlay ₹19,744 crore; 5 MMT per annum by 2030; ~125 GW RE).*

TREND 11 · OFFSHORE WIND

# Wind power heads out to sea

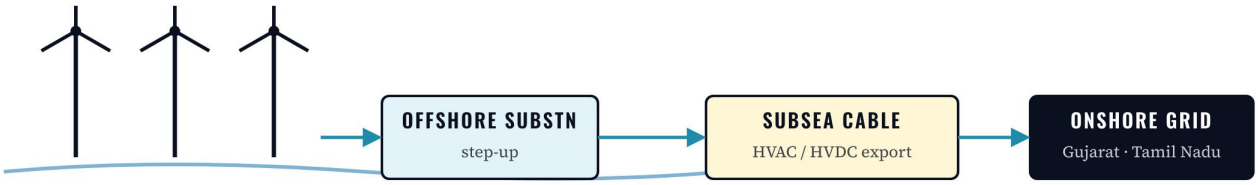
*In June 2024 India approved funding for its first offshore wind projects.*

| 1 GW | ₹7,453 cr | 3.72 BU |
|---|---|---|
| Offshore wind to be supported (500 MW each off Gujarat and Tamil Nadu) | Total outlay of the VGF scheme | Expected renewable electricity per year |

Winds at sea are stronger and steadier than on land, and India has a long coastline with excellent offshore wind potential. On 19 June 2024 the Union Cabinet approved a Viability Gap Funding scheme for the country's first offshore wind projects, including a grant to upgrade two ports for the heavy logistics involved.

Offshore wind is an advanced electrical-engineering challenge. Large turbines feed an offshore substation that steps up the voltage; long subsea cables — HVAC or, for longer distances, HVDC — carry the power to shore; and the whole system must meet strict grid codes for fault ride-through and reactive power.

The first 1 GW is part of a larger plan for 37 GW of offshore wind. For students, it points to careers in high-voltage engineering, cable systems, HVDC and marine power systems.




*Offshore turbines → offshore substation → subsea export cable → onshore grid.*

FOR EEE STUDENTS **High-voltage engineering, HVDC and cable systems are specialist fields with growing demand.**

LINKED SUBJECTS

**High Voltage Engineering · HVDC Transmission**

DID YOU KNOW?

For long subsea cables HVDC is preferred, because AC cables draw large charging currents over long distances.

*Source: Union Cabinet approval of VGF scheme for offshore wind (19 Jun 2024), pmindia.gov.in / narendramodi.in.*

SKILLS FOR THE FUTURE

# The EEE Toolkit for 2024 and Beyond

The trends in this magazine point to a clear set of skills. The table below links each technology to the subjects that build its foundation, the software tools worth learning, and the kinds of jobs it creates. Students can use it to choose electives, mini-projects, internships and certification courses.

| Technology | Core subjects | Tools to learn | Career roles |
|---|---|---|---|
| **Solar & wind** | Power Systems, Power Electronics, Renewable Energy Sources | PVsyst, MATLAB/Simulink, ETAP | Solar design engineer, O&M engineer, grid-integration engineer |
| **Rooftop solar** | Electrical Distribution, Utilization of Electrical Energy | PVsyst, AutoCAD Electrical, Excel | Rooftop installer, energy auditor, DISCOM engineer |
| **Battery storage** | Power Electronics, Electrical Measurements | MATLAB/Simulink, PLECS, Python | BESS engineer, BMS developer, PCS engineer |
| **Electric vehicles** | Electrical Machines, Power Electronics, Control Systems | MATLAB/Simulink, LTspice, Arduino | EV powertrain engineer, charging-infrastructure engineer |
| **SiC / GaN power electronics** | Power Electronics, Electronic Devices & Circuits | LTspice, PLECS, KiCad | Power-electronics designer, test engineer |
| **Semiconductors** | Electronic Devices, Digital Electronics, VLSI basics | Verilog, Cadence/Synopsys tools | Device test engineer, fab facility engineer |
| **AI & IoT in power** | Control Systems, Microprocessors, Data analysis | Python, MATLAB, NodeMCU / Raspberry Pi | Data analyst (energy), IoT developer |
| **Smart grids** | Power Systems, Switchgear & Protection, Communication | ETAP, PSCAD, SCADA software | Protection engineer, SCADA engineer |
| **Grid operation** | Power System Operation & Control, Analysis | PowerWorld, MATLAB, ETAP | Load-dispatch engineer, planning engineer |
| **Green hydrogen** | Power Electronics, Electrical Machines | MATLAB/Simulink, PSIM | Electrolyser plant electrical engineer |
| **Offshore wind & HVDC** | High Voltage Engineering, HVDC Transmission | PSCAD, DIgSILENT PowerFactory | HV engineer, cable-systems engineer |

FREE LEARNING RESOURCES

NPTEL and SWAYAM courses on power electronics, smart grids, electric vehicles and renewable energy; MATLAB Onramp courses; IEEE Xplore and NDLI through the college library; and the Skill India Digital portal for short certifications. A certificate in any one of these areas adds real value to a student's profile.

PHOTO GALLERY

# Industrial Tour — Glimpses from Mysuru

*EEE students and faculty during the department's industrial tour, which included visits to the heritage landmarks of Mysuru and Srirangapatna.*



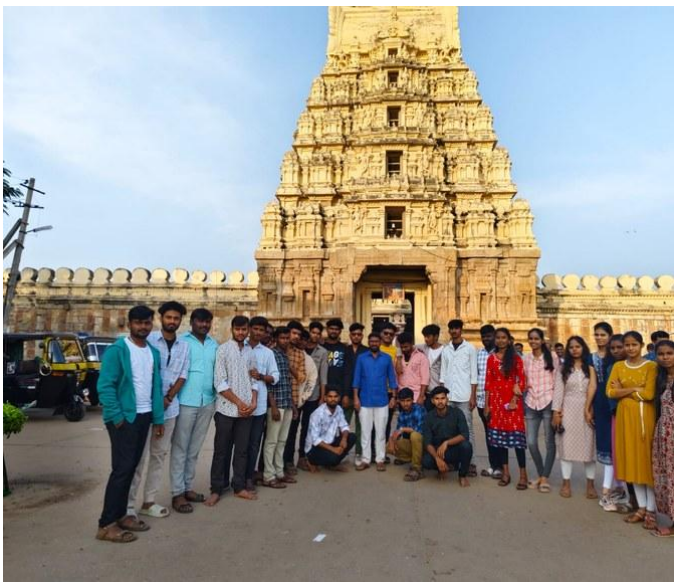
**Sri Chamundeshwari Temple, Chamundi Hills, Mysuru**
INDUSTRIAL TOUR · AY 2023–24



**Gumbaz, Srirangapatna**
INDUSTRIAL TOUR · AY 2023–24



**The tour group at Chamundi Hills**
INDUSTRIAL TOUR · AY 2023–24



**Sri Ranganathaswamy Temple, Srirangapatna**
INDUSTRIAL TOUR · AY 2023–24

STUDENT ACHIEVEMENT

# University Gold Medal — JNTUA

| 88.25% | 2020–24 | Gold |
|---|---|---|
| AGGREGATE IN B.TECH EEE | GRADUATING BATCH | UNIVERSITY MEDAL · JNTUA |



**D. Sabiya Sultana with her university gold medal**

B.TECH EEE · BATCH 2020–24

GOLD MEDALLIST

## D. Sabiya Sultana

B.Tech, Electrical & Electronics Engineering · Batch 2020–24

The Department of EEE is proud to announce that **D. Sabiya Sultana** of the 2020–24 batch has been awarded the **University Gold Medal by Jawaharlal Nehru Technological University Anantapur (JNTUA)**, securing an aggregate of **88.25%** in B.Tech (EEE).

The medal recognises four years of steady, consistent academic work and brings honour to her family, her teachers and GATES Institute of Technology.

Her achievement is an example for every student of the department: regular study, curiosity and discipline turn into results that last.

ACHIEVEMENT PROFILE

| | | | |
|---|---|---|---|
| NAME | D. Sabiya Sultana | BRANCH | B.Tech – Electrical & Electronics Engineering |
| BATCH | 2020–24 | AGGREGATE | 88.25% |
| AWARD | University Gold Medal | AWARDED BY | JNTUA, Ananthapuramu |

CONGRATULATIONS

The Management, Principal, Head of the Department, faculty and students of the Department of EEE congratulate D. Sabiya Sultana on this outstanding achievement and wish her every success in her career.

PHOTO GALLERY

# Campus Moments 2023–24



**Students during a department programme**
DEPARTMENT OF EEE



**Learning together in the department**
DEPARTMENT OF EEE



**Guest lecture on advanced control techniques**
GUEST LECTURE



**Soft-skills workshop in progress**
WORKSHOP

## From the editorial desk

We thank the management, the Principal, faculty members, resource persons and students whose work fills these pages. Readers are welcome to send articles, project write-ups and photographs for the next issue of Spark Era to the Department of EEE.

# DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

## DEPARTMENT VISION

**To impart the best technical education instilled with discipline, values and leadership qualities that will produce professional technocrats in Electrical and Electronics Engineering.**

## DEPARTMENT MISSION

**M1: To impart fundamental Electrical and Electronics Engineering concepts and a broad set of technical skills.**
**M2: To prepare Electrical and Electronics Engineering graduates who will engage effectively and responsibly in practicing engineering.**
**M3: To impart practical exposure on latest technological developments in Electrical and Electronics Engineering.**

## Program Educational Objectives (PEO's)

**On successful completion of UG in Electrical and Electronics Engineering, the Graduates will:**

**PEO1: Have a successful professional career with a strong foundation in basic sciences, along with in-depth knowledge of electrical engineering.**
**PEO2: Pursue higher studies to contribute for the betterment of the society.**
**PEO3: Continue in their chosen profession by practicing lifelong learning.**

## Program Specific Outcomes (PSO's)

**PSO1: Using Power Electronics knowledge in conjunction with Electrical Machines understanding to create an engineering solution in the domains of Electrical Drives.**
**PSO2: Develop innovative cutting-edge technologies in power systems related to efficient electrical power conversion and control.**