SUSTAINABLE ENERGY ENGINEERING

POST GRADUATE PROGRAM
SUSTAINABLE ENERGY ENGINEERING

For sustainable development and for maintaining quality of life of citizens of India as well as elsewhere in the world, energy sustainability is a vital concern. We need to understand that our energy needs are met in such a manner so that energy is conserved, managed better and produced using methods that are environmentally benign and have lower carbon footprint. The indigenous development of new, clean, alternative and renewable energy technologies necessitates strong education and R&D base in the country with focused academic programmes to develop competent human resources. The Department of Sustainable Energy Engineering or SEE (www.iitk.ac.in/see) will impart high quality education and training to its students in various aspects of energy sustainability via vibrant postgraduate programmes.

The research portfolio of the Department is envisioned into four broad verticals: (i) Energy Generation, (ii) Energy Storage, Distribution and Usage, (iii) Alternative Fuels, and (iv) Energy, Environment, & Policy which align well with the national and global domains in energy sustainability. The research areas in these verticals can be seen in the illustration shown below.

Illustration: Research verticals of the Department and the topics therein

<table>
<thead>
<tr>
<th>Sustainable Energy Engineering @ IITK</th>
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<tbody>
<tr>
<td><strong>1. Energy generation</strong></td>
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<tr>
<td>- Solar energy</td>
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<tr>
<td>- Wind energy</td>
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<tr>
<td>- Fuel-cells</td>
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<tr>
<td>- Hydro, tidal and geothermal</td>
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<tr>
<td>- Nuclear</td>
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<tr>
<td>- Hydrogen</td>
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<tr>
<td>- Waste-to-energy</td>
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<td>- CO₂ to fuels</td>
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<td><strong>2. Energy storage</strong></td>
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<td>- CO₂ sequestration, storage and utilization</td>
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<td>- Hydrogen storage</td>
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<tr>
<td>- Solar thermal storage</td>
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<tr>
<td>- Electrochemical storage: Batteries, capacitors etc</td>
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<td><strong>3. Energy transmission and efficiency</strong></td>
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<td>- Electrical mobility</td>
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<td>- Batteries</td>
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<td>- Charging</td>
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<td>- Smart grid</td>
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<td>- Power distribution and integration</td>
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<tr>
<td>- Energy efficiency</td>
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<td>- Smart buildings</td>
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<td><strong>4. Energy policy, economics and Climate</strong></td>
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<tr>
<td>- Energy policy and economics</td>
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<td>- Energy efficiency, conservation and management</td>
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<tr>
<td>- Climate studies and modelling</td>
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The Department will place a special emphasis on (i) solar energy conversion and storage via photovoltaics and thermal methods for energy generation, (ii) contemporary and novel battery, fuel-cell and supercapacitor materials, devices and architectures, prototypes, and system development for electric vehicles, (iii) smart grid and power distribution, (iv) hydrogen as a clean fuel with emphasis on production and storage, (v) carbon capture and (vi) clean water. The faculty of the department has core strengths in science and engineering whose research domains are in various aspects of sustainable energy engineering. The aim of the academic programmes will be to develop engineers who will be able to connect the fundamental nuances of science and engineering of energy sustainability with energy systems development. The department also aims to make meaningful international collaborations to benefit its students. In this direction, it already has strong linkages with Rice University in the form of Rice-IITK Collaborative Center (www.iitk.ac.in/rice-iitk/) at IITK. Such initiatives are expected to provide the students opportunities for international exposure and collaborations.
POST-GRADUATE PROGRAMMES OFFERED

- M.Tech.
- M.S. (by Research)
- Ph.D.

The detailed admission procedure along with the eligibility criteria can be found at:

(i)  www.iitk.ac.in/doaa/admission-procedure
(ii) https://iitk.ac.in/doaa/data/pgmanual-02Sep2015.pdf

LABS/FACILITIES

Teaching Laboratory:
Sustainable Energy Technologies lab consisting of experiments related to student training on solar photovoltaics, solar thermal, storage, hydrogen and fuel cells, smart grid, wind energy, basic electronics, temperature and flow measurements, Materials synthesis and characterization

Key research laboratories:
- Solar photovoltaics fabrication laboratory
- Battery materials and cell development and characterization laboratory
- Hydrogen generation and storage laboratories
- Smart grid facilities
- Solar thermal systems

Institute facilities:
- Advanced center for materials science
- Advanced imaging center
- Nanoscience center
Core faculty:

- **Prof. Aakash Rai**
  *Expertise*: Energy-efficient buildings, impact of climate change on energy consumption in buildings, air pollution measurements, modeling & control, and low cost devices for air pollution management

- **Prof. Amarendra Edpuganti**
  *Expertise*: Power electronics applications in renewable energy, electric vehicles, and fuel cell vehicles

- **Prof. Ashish Garg**
  *Expertise*: Energy material development for photovoltaics, batteries, hydrogen, CCUS, energy policy, decarbonization, and recycling

- **Prof. Ashoke De (Jointly with Aerospace Engg.)**
  *Expertise*: Energy Harvesting, Wind & Hydro Energy, Modelling

- **Prof. Debopam Das (Jointly with Aerospace Engg.)**
  *Expertise*: Wind energy, Computational Fluid Dynamics, UAVs

- **Prof. Deepika Swami**
  *Expertise*: Energy Policy and Climate Change

- **Prof. Kanwar Singh Nalwa**
  *Expertise*: Solar cells (Device physics, Materials, Characterization), Energy storage materials and devices (Na-ion and Liquid metal batteries)

- **Prof. Lalit M. Pant**
  *Expertise*: Electrochemical energy conversion and storage, numerical modelling, porous media transport

- **Prof. Laltu Chandra**
  *Expertise*: Battery thermal management system, computation and experiment for heat transfer and fluid flow, dust transport and deposition, heat transfer with nanofluids, solar thermal sub-systems design, thermochemical hydrogen generation, turbulent flow simulation and modelling.

- **Prof. Prabodh Bajpai**
  *Expertise*: Hybrid AC-DC microgrids, smart grid and renewable integration, solar photovoltaics, electricity markets, power system analysis and control.

- **Prof. Rajeev Jindal**
  *Expertise*: Energy technology and policy, carbon neutrality, c-Si solar cells and metal-ion batteries

- **Prof. Sachhida Nand Tripathi**
  *Expertise*: Climate issues, climate modelling, environment, and air pollution

- **Prof. Sudarshan Narayanan**
  *Expertise*: Solid state batteries (solid electrolytes, anode materials), thin films for energy conversion (transparent conductors, low-emissivity coatings), and advanced characterization

- **Prof. Srinivas Karthik Yadavalli**
  *Expertise*: Halide perovskites, solar cells (single-junction and tandem), multi-junction photoelectrodes for green hydrogen, and recycling of photovoltaic materials

- **Prof. Vaibhav Arghode (Jointly with Aerospace Engg.)**
  *Expertise*: Solar Thermal Energy

Adjunct Faculty:

- **Prof. Abheejeet Mohapatra**
  *Expertise*: Power system security, Uncertainty modelling
FACULTY LIST

• Prof. Abhishek
  Expertise: Wind Energy, Rotary Wing Aeromechanics

• Prof. Anand Singh
  Expertise: Energy materials development

• Prof. Ankush Sharma
  Expertise: Power Systems, Smart Grid Technology

• Prof. Anoop Singh
  Expertise: Energy economics

• Prof. Anubha Goel
  Characterization of emissions from vehicular exhaust, indoor and ambient air quality assessment, size segregated distribution of particles and organic pollutants on aerosols, health risk assessment, solid waste management, and agricultural impact on climate change

• Prof. Goutam Deo
  Expertise: Catalysis, Carbon capture

• Prof. Gururaj Mirle Vishwanath
  Expertise: PV and wind integration in power systems, electric vehicle challenges (G to V and V to G), machine learning applications for power systems, ancillary services, microgrids operation and control

• Prof. Himanshu Sharma
  Expertise: Carbon capture, alternative fuels

• Prof. Jayant K. Singh
  Expertise: Materials design, Computational Materials

• Prof. Jishnu Bhattacharya
  Expertise: Storage materials development, modelling

• Prof. Malay K. Das
  Expertise: CH₄ Recovery from gas hydrate, CO₂ sequestration, Electrochemical Energy Conversion and Storage

• Prof. Nishith Verma
  Expertise: Adsorption, Synthesis of nanomaterials including adsorbents and catalysts, Environmental Pollution Control (air/water purifications), Carbon-based Electrodes

• Dr. Parthasarathi Sensarma
  Expertise: Power Electronics for Renewable Generation

• Prof. Pradip Swarnakar
  Expertise: Environmental Sociology, Climate Change Policy

• Prof. Raja Angamuthu
  Expertise: Storage materials development

• Prof. Raju Kumar Gupta
  Expertise: Storage materials and devices, Solar energy materials and devices, Water Remediation, Hydrogen production, Carbon Capture and Conversion

• Prof. Shobhit Omar
  Expertise: Storage and fuel-cells materials and devices development

• Prof. Suvendu Samanta
  Expertise: Power Electronics, Electric Vehicles, Wireless Power Transfer, Resonant Converters with WBG Devices
FACULTY LIST

- **Prof. Swathi Battula**

- **Prof. Vishal Agarwal**
  **Expertise:** Computational Catalysis, Biofuels and CO2 conversion
BROAD RESEARCH AREAS

- Solar Photovoltaics
- Solar Thermal
- Wind Energy
- Batteries and Supercapacitors
- Fuel Cells
- Electric Vehicles
- Hydrogen and alternative fuels
- Carbon Capture and Utilization
- Water
- Smart Grid and Renewables Integration
- Energy Economics, Policy and Regulation
- Building design
- Energy Efficiency
- NetZero and Carbon Neutrality
SUSTAINABLE ENERGY ENGINEERING DEPARTMENT

CONTACT

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Webpage: https://www.iitk.ac.in/see/pg-programme
List of Course: https://www.iitk.ac.in/see/list-of-PG-courses