



Brochure

CENTRE FOR ENERGY

IIT GUWAHATI

2020



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## Message from Director

Energy is vital for our day to day existence. It directly reflects the well-being and prosperity of a nation and is the key factor to our economic growth. Current global energy scenario calls for technological interventions that would enable us to increase the share of renewable energy and lessen the use of natural resources through increased conservation. IIT Guwahati is proud to be also contributing to this global cause through a dedicated centre for energy. The vision of the Centre is to allow academicians and researchers from different disciplines from both within and outside the institute to meet on a common platform and work unitedly to find solutions to meet the energy demand of different sectors utilizing the renewable resources available in abundance in a holistic manner. So far, the Centre has successfully lived up to its mission and in the succeeding years I foresee it to develop to an energy hub with advance state-of-art facility in cutting edge research for generating human resources and laboratory-to-field technology.



**Prof. Dr. T.G. Sitharam**  
Director, IIT Guwahati

## Message from Head



**Prof. Kaustubha Mohanty**  
Head, Centre for Energy  
IIT Guwahati

Employing the natural resources to meet the growing demand for energy in a safe and environmentally responsible manner is a key challenge. We need to be committed to protect both the people and the environment while utilizing the resources and simultaneously contribute towards energy security as well as economic development. Centre for Energy at IIT Guwahati, founded in the year 2004 has been an effort to contribute to serve the cause. Being located in Guwahati, the gateway to the North-East India, it envisions to cater to the energy needs of the entire region academically, technologically and intellectually. Currently the Centre is focusing on (i) Energy generation (through thermochemical route, biochemical route, biofuel, fuel cell, solar, catalyst development and solar-wind hybrid), (ii) Energy storage (Li-ion Battery, compressed air and metal hydride) (iii) Energy transmission (nano-fluid, metamaterials) and (iv) Development of integrated systems and innovative products. The Centre is actively participating in *Unnat Bharat Abhiyan*, *Rastriya Avishkar Abhiyan*, and *Uchhatar Avishkar Abhiyan* and aims to significantly contribute to Make in India, Skill India, Imprint India, Solar Mission, GIAN and other complementary initiatives of the Govt. of India. The Centre runs two academic programs: **PhD** and **MS by Research**. At present, there are 30 MS(R) students and 80 PhD students working on various aspects of energy research. I welcome all to be a part of our endeavour by joining the Centre at either of the two academic programs, through academic and research collaboration, through consultancy or approaching us on any relevant issue for that matter. Our success lies in finding solutions for energy security locally, regionally, nationally and globally by striving unitedly.

## About IIT Guwahati

Indian Institute of Technology Guwahati, the sixth member of the IIT fraternity, was established in 1994. The academic programme of IIT Guwahati commenced in 1995. At present the Institute has eleven departments and five inter-disciplinary academic centres covering all the major engineering, science and humanities disciplines, offering BTech, BDes, MA, MDes, MTech, MSc and PhD programmes. Within a short period of time, IIT Guwahati has been able to build up world class infrastructure for carrying out advanced research and has been equipped with state-of-the-art scientific and engineering instruments. Indian Institute of Technology Guwahati's campus is on a sprawling 285 hectares plot of land on the north bank of the river Brahmaputra around 20 km. from the heart of the city. With the majestic Brahmaputra on one side, and with hills and vast open spaces on others, the campus provides an ideal setting for learning.

**IITG ranked 470th in QS global world ranking 2021**

**IIT Guwahati ranked 350th in the Overall World Category and 6th in Overall India Category in the Nature Index Annual Ranking 2020**

**IIT Guwahati is in the 8th position in "OVERALL" category and in the 7th position in "ENGINEERING" category in MHRD-NIRF Ranking 2017**

## About North-East India

North-East India (officially North Eastern Region, NER) is the easternmost region of India representing both a geographic and political administrative division of the country. It comprises eight states – Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. NE is the land of undulating hills and plains with luxuriant green cover and a wide variety of rare and exotic flora and fauna. The states of Arunachal Pradesh and Nagaland are home to unique tribal cultures. Kaziranga and Manas National Parks in Assam are the best places on earth to see the one-horned rhino as well as diverse bird life.



# About Centre for Energy

Centre for Energy at IIT Guwahati was established in May, 2004 to promote multidisciplinary activities focused to various facets of energy technology and systems in the form of research, teaching and consultancy. The research activities in the Centre are in the form of research based projects funded by various national and international funding agencies. Looking into the potential and application of different energy resources from the north eastern region of India, it is emphasized that the Centre gives priority to activities in the field of bio-energy, small hydro-power, alternative fuels, clean coal technology, combustion and energy efficiency of systems etc. Faculty members from various departments of the institute such as Biosciences and Bioengineering, Chemical Engineering, Civil Engineering, Design, Electronics and Electrical Engineering, Mechanical Engineering, and Physics are associated with the Centre for the promotion of interdisciplinary research for sustainable energy. At present, 17 (seventeen) faculty members from different departments are involved in energy research through sponsored and consultancy projects from various sponsoring agencies. To support the research work in the projects, the Centre has two academic programmes - Doctor of Philosophy (PhD) and Master of Science by Research (MS-R). The facilities available at the Centre have been a great support for the students working in different areas at IITG as well for the students of various academic and research institutions.

## Mission

To create State of the Art facilities for research in sustainable energy and cater as a hub for the entire North Eastern Region of India.

## Vision

Sustainable solution for Energy Generation, Energy Storage and Energy Transmission

## Broad areas of Research

Energy Generation  
Energy Storage  
Energy Transmission  
Energy Policy and Management

## Collaboration with Foreign Universities

- Technical University of Denmark (DTU), Denmark
- University of Buenos Aires, and IQUIBICEN-CONICET, Argentina
- Shantou University, China
- Irkutsk State University, Russia
- Gifu University, Japan
- Universite Cathalique de Lowain, Belgium
- University of Nottingham, UK
- University of Loughborough, UK
- University of Birmingham, UK
- Cranfield University, UK



# Programmes Offered

## PhD

The **Ph.D. programme** consists mainly of an open-ended research work that is expected to make a contribution to science and technology. Major goal of the Centre is to provide students with a broad variety of educational experiences: developing their problem solving skills, challenging them with open-ended problems and design projects, providing opportunity for teamwork, developing their written and verbal communication skills, and making research or independent study experiences available to those students with the desire and capability. PhD programme under the Centre started from July 2005. Every year intake capacity for PhD students are increasing. Students are admitted twice in a year, in July and December.

### *Eligibility Criteria:*

Master's degree in Engineering/Technology/Design/Architecture/ Medical Sciences in relevant area with a minimum CPI of either 6.0 or 60% marks.

Four-year Bachelor's degree in Engineering/Technology/Medical Sciences or equivalent in a relevant area with a minimum CPI of either 7.0 or 70% of marks.

Master Degree in Science in relevant area with a minimum CPI of either 6.0 or 60% of marks.

## MS(R)

The Centre for Energy at IIT Guwahati has been serving as the platform for multi-disciplinary energy research with the activities through sponsored and consultancy research projects being implemented in the Centre by the faculty members from different departments. The PhD students and project staff (JRF, SRF, RA etc) are the working force for executing the works to reach the committed objectives in the projects. In order to increase the vibrancy of R&D work, The Centre has started **Master of Science by Research, MS(R)** programme in 2015. The MS(R) programme would be distinct from the currently offered MTech programme in the institute in terms of the credit structure of the theory course because the MS(R) programme will have less credit on the theory course and more on the project work.

### *Eligibility Criteria:*

BE/B.Tech/ MSc. Degree or equivalent in any discipline with a minimum CPI of either 6.0 or 60% of marks.

### *Courses Offered:*

- Fundamental of Energy Engineering
- Renewable Energy Systems
- Operation and Instrumentation Lab
- Energy Efficiency, Planning and Management
- Energy Storage Systems
- Solar Energy Conversion and Technology
- Inter Departmental Electives
- Thesis Project, completed in three semesters.



# Ongoing Sponsored Research Projects

- Installation and Commissioning of Biogas Power generation (Off-Grid) of 400 m<sup>3</sup> biogas generation capacity with an estimated power generation capacity of 50 kW, MNRE.
- Biocatalytic desulphurization of crude oil by high performing genetically engineered microorganisms, CSIR.
- Innovative Algae Platform for Industrial Wastewater Valorization (InWAP), Indo-Danish Research and Innovation Cooperation in the area of Water, DBT.
- Enhanced carbonate precipitation of ureolytic and nitrifying microbe treated rubber wastewater, DBT.
- Bioconversion of organic wastes and de-oiled algal residue into biodiesel and value added products (carotenoids etc.) using oleaginous yeast and cellulolytic fungi, DBT.
- Bioremediation and Bioconversion of Waste with complex Photosynthetic Organisms and Heterotrophs under Aerobic and Anaerobic Conditions with Generation of Bioenergy, DST.
- Fabrication, Characterization and Optimization of a 'Duckweed Water Treatment Plant' for removal of As and FI from water and bioremediation with scope for value added technologies, DST.
- Design, Optimization and Intensification of a Bioprocess for Converting North East Natural Gas into Liquid Fuels (Bio-GTL), DBT.
- Biogas Development and Training Centre under New National Biogas and Organic Manure Programme (NNBOMP), MNRE.
- Development of renewable energy technology package for clean power generation in remote utility, DST.
- Efficient utilization of sugarcane top for production of cellulosic ethanol and other value added products, DBT.
- Bio-Inspired Adaptive Advance Solar Building Envelope, DST.
- Metal hydride materials and systems for the increase of efficiency in renewable and hydrogen energy, BRICS Multilateral Research and Development Projects, DST.
- Reversible Alkali Metal Based Hydrides for High Temperature Thermal Energy Storage, DST.
- Pilot Scale study for biodiesel production using waste rubber seeds as raw material, MHRD.
- Techno-Economic Analysis of Oil and Gas well based Microgrid Power Management System in Assam, ABB.
- Pilot scale study for biodiesel production using waste rubber seeds as raw material, Uchchatar Avishkar Yojana, MHRD.
- Membrane based efficient energy storage, clean energy generation and waste water treatment system, DST.

## Research Collaboration

- Waterless and Contactless Solar Panel Cleaning Solution, Forum India Pvt. Ltd.
- Assessment of Various Energy Saving Techniques in HVAC Systems Employed Across CPL, M/s Cadila Pharmaceuticals Ltd.
- Development of comprehensive interactive well monitoring software tool for drilling supervisors, IDT-ONGC
- Feasibility study on metamaterial based wireless power transfer from MTRDC, DRDO, Bangalore





# Lab and Facilities

- Bioenergy Laboratory
- Analytical Laboratory
- Bio-Fuel Laboratory
- Process Development Laboratory
- Fuel Cell Laboratory
- Solar Energy Lab





# Faculty Members



**Prof. Kaustubha Mohanty**, Professor, Dept. of Chemical Engineering and Head Centre for Energy

**Area of Interest:** Biofuels, Biomass Pyrolysis, Heterogeneous Catalysis for Energy Applications, Microalgae Biorefinery, Waste-to-Energy, Water-Energy-Nexus



**Prof. Pratima Agrawal**, Professor, Dept. of Physics

**Area of Interest:** Condensed Matter Physics (Experimental); Amorphous Semiconductor Materials and Devices Nanocrystalline semiconductors



**Dr. Harsh Chaturvedi**, Asst. Professor, Centre for Energy

**Area of Interest:** Printed Flexible Electronics, Device Fabrication, PV, Battery supercapacitor, Hybrid Nanomaterials



**Prof. Debasish Das**, Professor, Dept. of Bioscience and Bioengineering

**Area of Interest:** Bioprocess engineering, Modeling of Biological system and process, Process development for sustainable biofuel



**Dr. Mahuya De**, Professor, Dept. of Chemical Engineering

**Area of Interest:** Catalysis and reaction engineering, adsorption, hydrocarbon processing



**Prof. Pranab Goswami**, Professor, Dept. of Biosciences and Bioengineering

**Area of Interest:** Biosensor and Biofuel Cell Research



**Prof. Vaibhav V. Goud**, Professor, Dept. of Chemical Engineering

**Area of Interest:** Bio-energy, Biolubricant, Utilization of Lignocellulosic Biomass for Fuel/Chemicals, Algal-Biofuels, Application of Supercritical Fluids



**Prof. Arun Goyal**, Professor, Dept. of Biosciences and Bioengineering

**Area of Interest:** Bio-energy, Recombinant cellulolytic and xylanolytic enzyme production, Lignocellulosic ethanol production, Recovery of Value added extractives



**Prof. Karuna Kalita**, Professor, Dept. of Mechanical Engineering

**Area of Interest:** Rotordynamics, Coupled Dynamics of Electro-Mechanical Systems Vibration



**Dr. Pankaj Kalita**, Asst. Professor, Centre for Energy

**Area of Interest:** Hybrid solar collectors (PV/T) · Fluidized bed combustion and gasification technology · Energy Storage · Rural Energy and energy management





**Prof. Vinayak Kulkarni, Professor, Dept. of Mechanical Engineering**

**Area of Interest:** High enthalpy flows, scramjet engine, experimental, aerodynamics, measurement science, CFD simulations



**Prof. Pinakeswar Mahanta, Professor, Dept. of Mechanical Engineering**

**Area of Interest:** Thermal Radiation with Participating Media, Fluidization, Energy Conservation and Renewable Energy



**Prof. Vijay S. Moholkar, Professor, Dept. of Chemical Engineering**

**Area of Interest:** Bubble dynamics, CFD, Sonoprocess engineering, Biomass gasification



**Prof. P. Muthukumar, Professor, Dept. of Mechanical Engineering**

**Area of Interest:** Thermal energy storage, Hydrogen energy (storage and applications), Sorption heating and cooling systems, Porous medium combustion, Solar Drying



**Dr. Sisir Kumar Nayak, Asso. Professor, Dept. of EEE**

**Area of Interest:** Renewable power generation and grid integration, High voltage and pulsed power



**Prof. Harshal B. Nemade, Professor, Dept. of EEE**

**Area of Interest:** Electronic instrumentation, energy harvesting devices, systems design and integration



**Prof. Ujjwal K. Saha, Professor, Dept. of Mechanical Engineering**

**Area of Interest:** Turbomachinery, Propulsion, Applied Aerodynamics, Wind Energy, Internal Combustion Engine



**Prof. Lingaraj Sahoo, Professor, Dept. of Bioscience and Bioengineering**

**Area of Interest:** Genetic engineering and functional genomics of plants.



**Prof. Niranjana Sahoo, Professor, Dept. of Mechanical Engineering**

**Area of Interest:** Internal combustion engines and aero-Engines, Thermal sensors and heat flux Sensors for combustion studies, Alternative Fuels and dual-fuel combustion, Emulsified and blended fuels, Wind energy



**Dr. Senthilmurugan Subbiah, Asso. Professor, Dept. of Chemical Engineering**

**Area of Interest:** Modeling and Optimization, Process Design and Operation of Membrane Separation Processes, Water management for oil and gas upstream, Smart Water Grid, Waste to Energy, Novel Desalination Technologies, Energy Storage, Smart Micro grids



# Latest Publications

1. Dudul Das, Urbashi Bordoloi, Akash Dilip Kamble, Harrison Hihu Muigai, Ranjith Krishna Pai, Pankaj Kalita, Performance investigation of a rectangular spiral flow PV/T collector with a novel form-stable composite material, **Applied Thermal Engineering**, 182, 2021, 116035.
2. Jain S, and Saha UK, (2020), On the influence of blade thickness-to-chord ratio on dynamic stall phenomenon in H-type Darrieus wind rotors, **Energy Conversion and Management**, Vol. 218, pp. 113024.
3. S. Buragohain, P. Mahanta, K. Mohanty, Experimental investigations of a 1kW Solar Photovoltaic plant in standalone and grid mode at different loading conditions, **Sustainable Energy Technologies and Assessments**, 41, 2020, 100796.
4. Jain S, and Saha UK, (2020), The state-of-the-art technology of H-type Darrieus wind turbine rotors, **ASME Journal of Energy Resources Technology**, Vol. 142, Issue 3, pp. 030801-1 - 030801-25.
5. "Optoelectronic properties of nano crystalline Silicon based superlattice structures" Pratima Agarwal & Asha Yadav, **Recent Advances in Thin Films**, Sushil Kumar and D.K. Aswal (Ed), Springer, (2020).
6. Shweta Singh, Vikky Rajulapati, Sumitha Banu J., Kedar Sharma, Vijayanand Suryakant Moholkar and Arun Goyal (2020) Efficient hydrolysis of pretreated Sorghum durra stalk by optimization using statistically designed cellulase mixture. **Industrial Crops and Products**, 154, 112678.
7. B. Malakar, D. Das, K. Mohanty, Optimization of glucose yield from potato and sweet lime peel waste through different pre-treatment techniques along with enzyme assisted hydrolysis towards liquid biofuel. **Renewable Energy**, 145, 2020, 2723-2732
8. S. Mishra, K. Mohanty, Co-HTL of domestic sewage sludge and wastewater treatment derived microalgal biomass - An integrated biorefinery approach for sustainable biocrude production, **Energy Conversion and Management**, 204, 2020, 112312.
9. M. Roy, K. Mohanty, Valorization of waste eggshell-derived bioflocculant for harvesting T. obliquus: Process optimization, kinetic studies and recyclability of the spent medium for circular bioeconomy, **Bioresource Technology**, 307, 2020, 123205.
10. Dawo, C., Afroz, M. A., Iyer, P. K., & Chaturvedi, H. (2020). Effect of UV-ozone exposure on the dye-sensitized solar cells performance. **Solar Energy**, 208, 212-219, 2020.
11. Bakaraju, V., Prasad, E. S., Meena, B., & Chaturvedi, H. (2020). An Electronic and Optically Controlled Bifunctional Transistor Based on a Bio-Nano Hybrid Complex. **ACS Omega**, 5(17), 9702-9706, 2020.
12. Viswanth Ramba, Senthil Selvaraju, Senthilmurugan Subbiah, Muthukumar Palanisamy, A Robust Anomaly Detection Methodology Using Predicted Hookload and Neutral point for Oil Well Drilling, **Journal of Petroleum Science and Engineering**, 2020.
13. S. K. Hotta, N. Sahoo, K. Mohanty, V. Kulkarni, Ignition timing and compression ratio as effective means for the improvement in the operating characteristics of a biogas fueled spark ignition engine, **Renewable Energy**, 150, 2020, 854-867, 2019
14. Dudul Das, Pankaj Kalita, Anupam Dewan and Sartaj Tanweer, Development of a novel thermal model for a PV/T collector and its experimental analysis, **Solar Energy**, 188 (2019) 631-643, 2019.
15. "Quantum Size Effect and tunable visible photoluminescence in a-Si:H/nc-Si:H superlattices", Asha Yadav, Pratima Agarwal and Rana Biswas, J. of Materials Science: **Materials in Electronics**, Vol 30 (2019) 4696-4704
16. Ashish J. Chaudhari, Santosh Hota, Vinayak Kulkarni and Niranjana Sahoo, "Combined Impact of Compression Ratio and Recirculated Exhaust Gas on the Performance of a Biogas Fueled Spark Ignition Engine" **Renewable and Sustainable Energy**, Vol. 11, 013104, 2019.
17. Ashish J. Chaudhari, Santosh Hota, Vinayak Kulkarni and Niranjana Sahoo, Effect of vertical location of the spark plug on the performance of a raw biogas fueled variable compression ratio spark ignition engine, **Energy and Environment**, DOI: <https://doi.org/10.1177/0958305X19841270>, Vol 30, Issue 7, 2019.
18. Sumitha Banu J., Abhijeet Thakur, Vijayanand S. Moholkar and \*Arun Goyal (2019) Elucidating the impacts of various pretreatments on the structural composition of Finger millet (Eleusine coracana) straw and optimization of hemicellulose saccharification by recombinant hemicellulases. **International Journal of Biological Macromolecules**, 135, 1098-1106.
19. Mrutyunjay Maharana, Niharika Baruah, Sisir Kumar Nayak, Niranjana Meher, and Parameswar Krishnan Iyer, "Condition Assessment of Aged Ester based Nanofluid Through Physicochemical and Spectroscopic Measurement", **IEEE Trans. Instrum. Meas.**, Vol. 68, No. 12, pp: 4853-4863, 2019.



# Latest Publications

20. Muniraja Tippa; Senthilmurugan s, Chockalingam Prathap, Impact of chamber volume on the measurement of laminar burning velocity using constant volume spherical flame method, **Fuel**, 2019.
21. Anil Kumar Rout, Niranjana Sahoo and Pankaj Kalita, Effectiveness of coaxial surface junction thermal probe for transient measurements through laser based heat flux assessment, **Heat and Mass Transfer**, 2019.
22. Sumitha Banu J., Abhijeet Thakur, Vijayanand S. Moholkar and Arun Goyal (2019) Elucidating the impacts of various pretreatments on the structural composition of Finger millet (*Eleusine coracana*) straw and optimization of hemicellulose saccharification by recombinant hemicellulases. **International Journal of Biological Macromolecules**.
23. A. Chaudhari, V. Kulkarni and N. Sahoo, State-of-the-art technology in variable compression ratio mechanism for spark ignition engine, **Sadhana – Proceedings of Indian Academy of Sciences**, 2018.
24. Sharma PK, Saharia M, Srivastava R, Kumar S, Sahoo L (2018) Tailoring microalgae for efficient biofuel production. **Frontiers Marine Science**.
25. Sharbani Kaushik, Pranab Goswami\*, Bacterial membrane depolarization-linked fuel cell potential burst as signal for selective detection of alcohol, **ACS Applied Materials & Interfaces**, 10 (22), 18630-18640, DOI: 10.1021/acsami.8b01838 (2018). This work has been highlighted in: The Hindu, May 26, 2018 as science news article: IIT Guwahati: Disposable biosensor selectively detects alcohol. The work has been highlighted in nature INDIA as Paper-based sensor detects alcohol.
26. Mrinal Kumar Sarma, Mohd Golam Abdul Quadir, Rupam Bhaduri, Sharbani Kaushik, Pranab Goswami\* Composite polymer coated magnetic nanoparticles based anode enhances dye degradation and power production in microbial fuel cells. **Biosensors and Bioelectronics**. 119, 94-102 (2018), DOI 10.1016/j.bios.2018.07.065 (2018). This work has been highlighted in nature INDIA: [http://www.natureasia.com/en/nindia/article/10.1038/nindia.2018.132?WT.ec\\_id=NINDIA-20181024](http://www.natureasia.com/en/nindia/article/10.1038/nindia.2018.132?WT.ec_id=NINDIA-20181024) (Impact factor: 10.25).

## Centre's Industrial Interaction Advisory Committee

**Mr. Sukumar Mandal**, Vice-President, Refining R&D, Reliance Industries Ltd., Jamnagar, Gujarat

**Mr. Deepak Gadhia**, CEO, Sunrise CSP Ltd., Vadodara, Gujarat

**Mr. Kiran Kumar Alla**, Director, Business Development, Bloom Energy India Pvt. Ltd., Hyderabad



# Activities



Short term Course on Clean Energy

National Conference on Waste to Energy



TEQIP-Short term course on "Energy Management and Energy Efficiency"



GIAN course on "Advances in Combustion and Gasification Technologies"



TEQIP-Short term course on "Recent Trends in Fuel Cell Technology"



TEQIP-Short term course on "Solar Energy Conversion and Management"



International workshop on "Frontier Energy Research with Industry Academia Partnership"



Training programme on 'Biogas and Vermicomposting'





# Contact Us

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