भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
Indian Institute of Technology Guwahati
www.iitg.ac.in

IIT Guwahati 1994 - 2019 25 years

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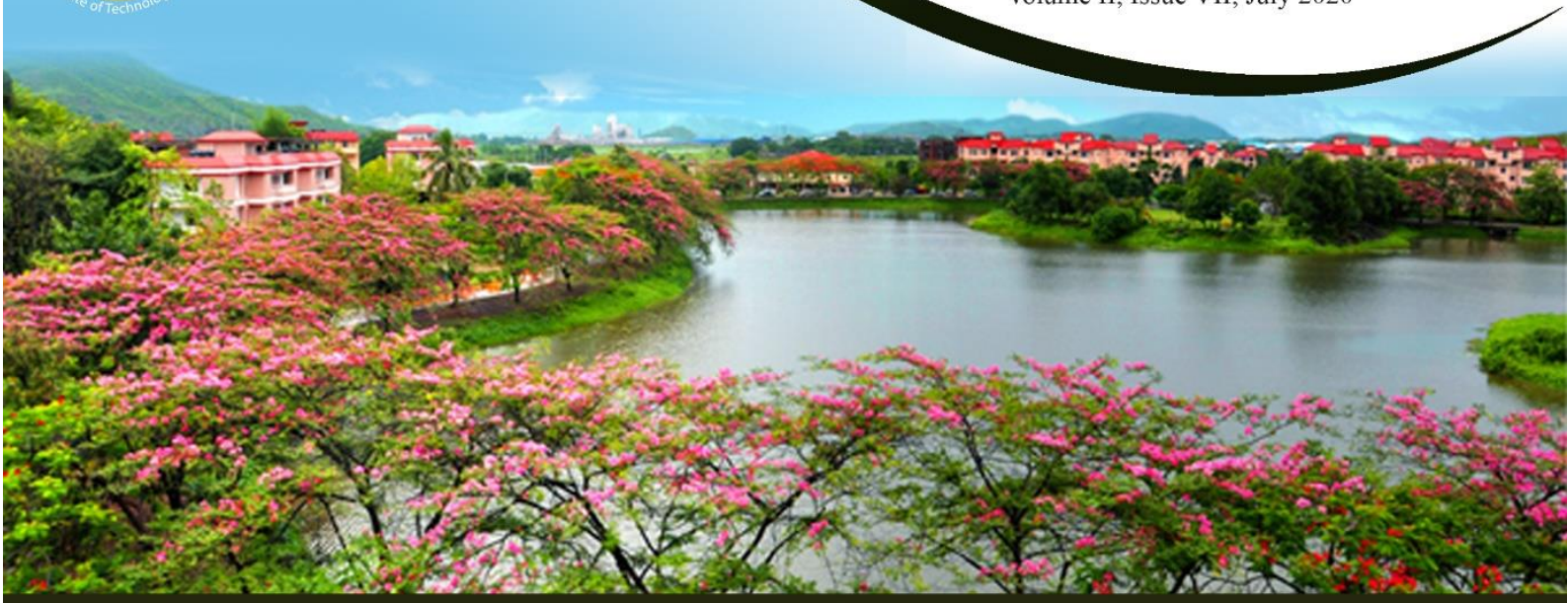
The Monthly Newsletter of IIT Guwahati

Volume II, Issue VII, July 2020



IIT Guwahati introduces the first-of-its-kind course on UN-Sustainable Development Goals 2030 as part of the B.Tech curriculum

Indian Institute of Technology Guwahati (IITG) has become the first IIT to introduce a course on UN-Sustainable Development Goals (SDGs) 2030 in the Bachelor of Technology (B.Tech) curriculum from this academic year (2020-2021).

In 2015, world leaders agreed at the United Nations General Assembly to implement 17 Sustainable Development Goals (SDGs) that are meant to transform the world, building upon the principle of "leaving no one behind". These 17 goals aim to create a better world by 2030, by ending poverty, fighting inequality, addressing the urgency of climate change and several other holistic approaches. Guided by the principles of these goals, this course provides a unique opportunity to the B.Tech students to understand the concepts of sustainability and work towards building a better society for everyone.

The course will be offered to the second year B.Tech students as a compulsory course, to reorient the thinking of young and dynamic individuals towards the path of sustainable development. Due to the interdisciplinary nature of the 17 Sustainable Development Goals, Department of Humanities and Social Sciences, the nodal department for this course, has collaborated and pooled resources from eight other departments of the Institute viz. Departments of Biosciences and Bioengineering, Civil Engineering, Chemistry, Chemical Engineering, Electronics and Electrical Engineering, Mechanical Engineering, Design and Physics – to design and implement the course. Faculty members from each of these departments will jointly conduct the course and will provide exposure to B.Tech students on the technological, economical, ecological and societal aspects of these 17 SDGs.

Prof. T. G. Sitharam, Director, IIT Guwahati, emphasised the urgent need to adopt these 17 goals as part of the curriculum so that the students who are the future leaders of the country are aware of the challenges for sustainable development and how their roles can lead to holistic development. Speaking about the introduction of this course, he said, "With only 10 more years remaining to fulfil these objectives, it becomes very vital that the students are taught about the goals of inclusive and sustainable growth and through this course, offered by faculty members from across engineering, science and humanities departments, IIT Guwahati wishes to prepare the students to play leading roles in 'Transforming the World'".

Prof. Anamika Barua, Course coordinator from the Department of Humanities and Social Sciences, IIT Guwahati, said, "This would be the first time the nine departments of IIT Guwahati have joined together to offer a course at the undergraduate level, realising that sustainability challenges and inclusive growth go hand-in-hand and has to be understood at the crossroads of science and society through an interdisciplinary lens". She further added, "The students, through this course, would be educated to critically evaluate the idea of Sustainability as an emerging discipline and have an opinion on the role for India, as a nation, in the successful implementation of the new SDGs".

Faculty members from all the nine disciplines will contribute in demonstrating the importance of adopting an interdisciplinary approach of sustainability. Several case studies will be used to demonstrate the ways of realising the SDGs and the strategies needed to move towards a sustainable pattern of development. The case studies will include topics from multiple disciplines such as growth, inclusive society, sustainable cities, transport, designs, technology, digital revolution, sustainable production & consumption etc. The course will also highlight the ways of financing the SDGs, the new financing mechanisms and global fund as well implementing SDGs through governance and policy tools.

It is envisioned that the new course will enable students to articulate the role of research for promoting Sustainable Development and meet the 169 targets as part of the 17 SDGs and how the sustainable development perspective relates to her/his own work and career goals.

Speaking about the intension behind the course, Prof. Vimal Katiyar, involved in designing the course and from the Department of Chemical Engineering, IIT Guwahati, said, "With this course, IIT Guwahati intends to nurture budding technocrats through sustainable technological practices to achieve an environmentally benign, safe and inclusive industrial ecosystem and foster innovations for the development of a sustainable society. This course would further embark upon a student's perception towards choosing ecologically accountable employment."

The course on SDGs will enable students to realise the importance of a stable relationship between human activities and the natural world for a healthy, clean and safe environment, and, thus, make them responsible individuals and the world a better place for inclusive growth and overall prosperity.

IIT Guwahati researchers produce biofuel from non-edible waste seeds

The team is led by Dr. Kaustubha Mohanty, Professor, Department of Chemical Engineering, IIT Guwahati. Results of the team's research have been published recently in high-impact journals such as Bioresource Technology, Fuel, Renewable Energy, Journal of Analytical and Applied Pyrolysis, Journal of the Energy Institute and Biomass Conversion and Biorefinery. Dr. Mohanty leads the team comprising research students, Dr. Ranjeet Kumar Mishra, Dr. Krushna P. Shadangi, Mr. Mithelesh Koul, Mr. Gautam Ganeshan and Mr. Gourav Chatterjee, who have coauthored these papers.

There have been worldwide attempts to produce fuel from renewable biological resources in order to overcome future oil shortages in the world. Currently, 'biofuels' are successfully made from vegetable oils and animal fats. In USA and Europe, for example, surplus edible oils like soybean oil and sunflower oil are being used for the production of biodiesel. The conversion of food resources to fuel compromises the global supply-demand of food, especially in developing countries with existing nutritional deficiencies.

"Oils derived from non-edible seeds of plants can be used to produce biofuels, to eliminate the competition between food and fuel", says Dr. Mohanty. Plants/trees found in India, such as peela kaner, mahua, gulmohar, neem, rain tree, castor, kusum etc., produce seeds that have oil from which biofuels can be made. Dr. Mohanty and his research team use a heat-chemical route to produce biofuels from these and other such seeds that they painstakingly collect from various parts of the country.

"We found that these non-edible seeds had a high amount of oil in them, which was exciting", says Dr. Mohanty. The researchers designed a low-cost pyrolyzer to obtain biofuel from these oils. While the yield of biofuel was very encouraging, there were some problems – the biofuel had lower acidity and high oxygen content, which made them unsuitable for use as transportation fuel.

To improve the properties of the biofuels derived from non-edible seed oils, the scientist used various catalysts such as calcium oxide, zeolite, etc., during the conversion of seed oil to biofuel. Both yield and

quality improved; the biofuels produced were comparable in properties to regular diesel, except for viscosity. "The higher viscosity of our biofuel is still a problem, but we'll find a way to overcome this", says the confident scientist.

Biofuel is not all they have obtained from these non-edible seeds. After purification of the oil derived from the seeds, the team was left with valuable chemicals in the discards, which find a plethora of industrial applications. One such remnant they could recover was hexadecanoic acid, which is used in making soaps, various cosmetic products, and release agents. Another was stearic acid that has numerous industrial applications. "This is truly a waste-to-value operation", says Dr. Mohanty. The team is seeking to understand the chemical mechanisms by which biofuels are produced from these sources and are studying their applicability in engines.

The team has not stopped with plant sources. They have derived bio-oil from a mixture of waste plastics and waste biomass. Single-use nitrile gloves used in lab and medical settings were used for this purpose.

"The demand for biofuel is expected to increase in future and it is certainly not sustainable to generate them from food sources" concludes Dr. Mohanty. This work is critical in the search for dedicated non-edible feedstocks for biofuel production.



Prof. K. Mohanty Dr. Ranjeet K. Mishra Dr. K. P. Shadangi


Mr. Mithelesh Koul Mr. Gourav Chatterjee

IIT Guwahati Researchers Show the Selective Transport of Carbohydrates in Cells by Protein Molecules called ABC Transporters

Indian Institute of Technology Guwahati researchers have shown how some specialised protein molecules found on the cell membranes of all biological cells carry carbohydrate molecules into cells from outside. They have studied specific protein molecules called ABC transporters, present in bacterial cell membranes and have shown that these transporters are selective about the type of carbohydrates they transport into cells.

The research team is led by Dr. Shankar Prasad Kanaujia, Associate Professor, Department of Biosciences and Bioengineering, IIT Guwahati. The work has been published in The FEBS Journal and the paper has been authored by Dr. Shankar Prasad Kanaujia and his Ph.D. students, Ms. Monika Chandravanshi and Ms. Prerana Gogoi.

Any living cell needs glucose for life-sustaining energy. Glucose in turn is obtained by the breakdown of carbohydrates – table sugar (sucrose), a simple carbohydrate, and starch, a complex carbohydrate, are some sources of glucose in the cell. Such carbohydrates must be taken into the cell, and broken down inside the cell into glucose. These carbohydrates are large molecules that cannot penetrate the membranes that surround the cell by themselves and depend on some special helpers or transporting molecules to carry them across.

"One of the largest classes of transporting molecules is the ATP-Binding Cassette (ABC) transporter, which is widespread in all forms of life", says Dr. Kanaujia. These special form of proteins present in the cell membranes of almost all living cells, capture the carbohydrates from outside the cell and deliver them into the cells.

Table sugar and starch are only two of the numerous carbohydrates that are used by the cells, and they have to be preferentially taken into the cell. While ABC transporters have been known for a long time, it remains unknown if these carbohydrate-ferries have preference for specific carbohydrates over others.

Many of the carbohydrates have similar structures and components, and differ in a specific type of bond

or linkage, called glycosidic bonds. There are two types of glycosidic bonds – alpha and beta. "We did not know if the ABC transporters have preference for any specific type of glycosidic bond", explains the researcher.

The IIT Guwahati team studied the ABC Transport system of a bacterium called Thermus thermophilus, that are present in hot springs. In order to survive the extreme environment, the bacterium utilizes many kinds of carbohydrates for energy. Is the ABC transport system in this bacterium inherently selective to specific carbohydrates or does it have no such preference? This is the question they have answered in their research.

"Based on the preliminary analysis of the ABC transport systems of the bacteria we chose, we hypothesized that it would have different affinities for different carbohydrates", says Dr. Kanaujia. To validate this hypothesis, the team used X-ray crystallography techniques to determine the three-dimensional crystal structure of the ABC transport system connected to various types of carbohydrates having different kinds of glycosidic bonds.

"The specific ABC transporters we studied had increased affinity to the alpha-glycosidic bonds", says the lead researcher. The team also found an interesting phenomenon – the transporters had a higher affinity for simple glucose than complex carbohydrates, which meant that any glucose in the extracellular space would be preferentially taken into the cells over higher carbohydrates.

These are interesting results in that they offer a better understanding of how carbohydrates are taken into cells. Defective transport of carbohydrates into cells is associated with a range of disorders, including cystic fibrosis, hypercholesterolaemia and diabetes. Understanding the mechanism of carbohydrate transfer by the ABC transporters would enable better understanding of the causes and effects of many of these disorders.

Dr. Shankar Prasad Kanaujia, Associate Professor, Department of Biosciences and Bioengineering, IIT Guwahati

Ms. Prerana Gogoi, Ph.D. student of Dr. Shankar Prasad Kanaujia, Associate Professor, Department of Biosciences and Bioengineering, IIT Guwahati

Ms. Monika Chandravanshi, Ph.D. student of Dr. Shankar Prasad Kanaujia, Associate Professor, Department of Biosciences and Bioengineering, IIT Guwahati

Prof. Hemangee K. Kapoor has been elected as the Vice President, ACM India Council (@IndiaACM).

Dr. Biranchi Panda has been awarded the "Graduate College Research Excellence Award" in the academic year 2019-2020 from Nanyang Technological University (NTU) Singapore for his excellent PhD work.

Prof. Tamal Banerjee, Department of Chemical Engineering, has joined the Editorial Board of Fluid Phase Equilibria. The journal is a core journal of Chemical Engineering and covers experimental, theoretical, and applied research related to equilibrium and transport properties of fluids, solids, and interfaces.

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