DEPARTMENT OF CHEMICAL ENGINEERING, IIT (ISM) DHANBAD

ChemE Chronicles

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FROM HOD'S DESK

PROF. ADITYA KUMAR

Dear friends and well-wishers,

Wishing all of you a Happy New Year! It is that time of the year, when we take resolutions to reach newer heights and achieve our targets, both at an individual and at a collective level. It is not always about achieving the target that matters, but also about our grit and determination that we develop along the way.

And when this grit and determination leads to tangible achievements, there is no greater joy! I am very happy to announce that the current issue of "ChemE Chronicles" highlights some of the achievements by our current students. We are indeed delighted to share news regarding the recent campus placements that have happened for the upcoming BTech and MTech graduates of our department. Both core as well as non-core placements are taking place across sectors, demonstrating the versatility of our students. Please note that the information regarding campus placements in this issue is not exhaustive - more to follow in the upcoming issues!

Apart from the usual campus placements in industries, a significant percentage of the graduating class also opt for higher studies, both in India and abroad.

While we hope to share with you more about that in the upcoming issues of "ChemE Chronicles", the " Alumni ChEnect" section of the current issue features a candid interview with one such MTech alumnus, who had opted for higher studies. I am hopeful that such anecdotes will inspire our budding chemical engineers to learn more about the path traversed by their seniors, and take inspiration from their stories of successes and (so-called) failures.

For every chemical engineering student, steam reforming is a classical process that is mandatorily taught in Chemical Technology course curriculum. The "ChemE Trivia" section delves deep into the steam reforming process and the associated history; I hope it would be an engaging read.

Understanding and controlling fluid flows is an integral part of successful process designing and operation across a range of natural and industrial applications. The "Feature Article" section provides a great introduction to the field, engaging the young readers with the details and intricacies of the same.

The Chemical Engineering Society recently held a Guest Lecture series by an industy expert from Indian Oil Corporation Limited - please read further details about the same in this issue.

We hope that the current issue of "ChemE Chronicles" will be an enriching read. As always, we heartily invite your thoughtful suggestions, comments, and constructive criticism; please write to us at che@iitism.ac.in

*Please send your suggestions to: che@iitism.ac.in

What's Inside

- Alumni ChEnect.
- ChemE Trivia
- Feature Article
- Guest Lecture
- Placements

Chemical Engineering News

Industry 4.0 and Cybersecurity

The chemical industry is embracing Industry 4.0 technologies, such as AI, machine learning, and IoT, to enhance efficiency, innovation, and sustainability. Concurrently, there's a growing emphasis on cybersecurity to protect data and ensure resilient operations in this increasingly connected industrial landscape Read More

India's Petrochemical Sector Growth

India anticipates an $87 billion investment in its petrochemicals sector over the next decade to address increasing demand. The sector's value is forecasted to grow from $220 billion to $300 billion by 2025, with domestic and state-run oil companies planning significant production expansions.Read More

SCHEMCON 2025

The Students Chemical Engineering Congress (SCHEMCON-2025) will be held on the theme of "Sustainable Development in Energy and Environment," highlighting the importance of sustainability in chemical engineering.Read More

Alumni ChEnect

DR. TAMOGHANA SAHA

MTECH [2014-2016]

Q. Welcome to the "Alumni ChEnect" interview series! Please tell us in detail about your current job.

I am currently a postdoctoral scholar in the Department of Chemical Engineering at University of California, San Diego since Feb. 2022. I finished my Ph.D. in Chemical Engineering from North Carolina State University in 2022. My current research focuses on developing next-generation non-invasive biosensing platforms for personalized health monitoring.

Q. Please tell us about your academic journey, starting from school days.

My fascination with soft materials during school motivated me to pursue an undergraduate degree in chemical engineering. The curriculum included subjects like polymer science, transport phenomena, and rheology, which deepened my interest in working with soft materials. By my final year, I decided to pursue a Ph.D. To gain global research exposure and join a renowned group in this field, I aimed to study abroad. However, coming from a non-IIT institute with limited research experience, I knew I needed to prove my abilities. To strengthen my profile, I cleared GATE and joined IIT-ISM for my Master's. My final year project, as proposed by Prof. Bhowmick, involved studying fluid drag effects in superhydrophobic channels. While not directly related to soft materials, the intense focus on transport phenomena and Prof. Bhowmick's passion kept me motivated. His mentorship led to two publications, making me the first in my batch to publish from Master's research. I even received the 2016 Ambuja's Young Scientist Award from IIChE. These publications even played a key role in my acceptance to a U.S. institute. In addition to this, I had a good GPA, GRE, TOEFL, and a focused statement of purpose on what I wanted to work during my PhD.

In 2017, I joined a renowned group at NC State, working on soft material synthesis and applications. I focused on conductive polymers, silicones, and hydrogels and even learnt how soft materials can be utilized to develop flexible electronics. My work involved studying the fundamentals of soft materials and using them to develop non-invasive wearable biosensors for sweat and interstitial fluid monitoring. My Ph.D. research resulted in five publications, two patent-pending inventions, and being a finalist in AIChE graduate student awards under Biomaterials category in 2021. Since 2022, I have been a postdoc in an electro-analytical lab, combining soft devices with novel redox cycling mechanisms to create miniaturized wearable platforms for continuous health monitoring. I aspire to hold an academic position in the future.

Q.Why did you choose chemical engineering? Was it out of passion, or driven by circumstances? Please walk us through your thoughts as a Class 12 pass-out.

During school, I enjoyed studying chemistry and physics and was fascinated by soft materials like bubble gum, plasticine, and clay putty, as they could be easily folded, twisted, or shaped. High school physics helped me understand the science behind their properties, which made me more curious about their real-world applications. This interest and the urge to study more on soft material properties, led me to choose chemical engineering over mechanical engineering for my undergraduate studies.

Q. How has IIT (ISM) Dhanbad helped you in this journey? How did the BTech/MTech/PhD programme here help shape your career path? How did the academic environment and campus life contribute to your personal growth?

I was part of the first M.Tech batch of ISM (2014-2016), and everything was in its early stages for us back then. I still remember having our first semester in the old, red-colored main building before moving to the new academic building in our second year. Despite limited resources, a strong course curriculum and guidance from a great research mentor kept me motivated toward my goals. I still have my notes on reaction engineering (from Sandilya Sir) and transport phenomena (from Soubhik Sir), haha! The hands-on research experience, dedicated teachers, and supportive batchmates made my time at ISM truly memorable.

The lab experience during my second year of M.Tech had a significant impact on shaping my career. It improved my analytical thinking, problem-solving skills, ability to overcome failures, research communication, and introduced me to scientific writing. These skills and lessons will stay with me forever.

What is your typical work-day like?

My day typically runs from 9am-7pm and includes lab work, mentoring students, meetings, presentations, cleanroom work, and a lot of writing (emails and science). Then from 10pm-1am, I again get back to writing (like papers, proposal writing, preparing job application packet etc.). Scientific writing usually consumes considerable amounts of my time. Also, I am a not a morning person, so I try to work more at night. What are the pros and cons of the profession in your honest opinion?

Well, my profession does involve several pros and cons.

Pros: (a) You keep interacting with different students on a daily basis. (b) Project timelines are flexible—you work on a project for a year or two and then move to the next one, allowing you to learn and explore more. (c) Your failure-to-success timeline is less penalizing. (d) You constantly learn from folks who are better than you in communication, presentation, experiments, or writing). (e) Helps you to test your mentorship skills as students keep coming and going. (f) All the time self-motivation gets tested, which keeps you going. Cons: (a) There is more chances for failure than success, but every failure has a unique story. The best thing is to accept it,

learn from it, and move on. (b) There are no fixed set rules to achieve your goals. For, e.g., a single research task can be achieved through many routes. Figuring out the optimized route is your task and so high chances to get lost if you do not know where to stop. (c) Outcomes and rewards (like a good publication and recognition) take time. E.g., I finished in 2016, but my publications came online in 2017, so I had to wait a year before starting grad school.

Q. How has your career evolved since you graduated, and what advice would you give to current chemical engineering students aspiring to follow a similar path?

I am really happy how my career has evolved since 2015. It has shaped me perfectly to acquire a faculty position in the future– a dream that I had since 2018. Thanks to my awesome mentors and colleagues who have supported me till date. Tips to Chem E students: Strengthen your undergraduate course knowledge thoroughly, as it will help you everywhere (industry and higher studies). Work on your analytical thinking capabilities. Develop the confidence to think, and visualize research problems, even outside your expertise. It's a good exercise in my opinion. You'll realize that most problems connect to chemical engineering concepts in some way. Don't pursue a higher degree as a backup plan. If you commit, do it with a clear purpose. I like telling myself that someone out there is doing my research in a much better way. Hence, always be self-driven, keep reading, and think of how your research can advance the field. Understand your research problem well. Know how to explain this problem to non scientific audience. If they appreciate it, you are clear about what you are doing. Have patience. Good things in your profession will take time. Always ask questions. Not knowing is worse than not having the urge to know what you don't know. Work on your soft skills. Be mindful of what, how much, and how you communicate. Gauge your audience before speaking or presenting. Always attend research presentation of other students and faculties. They're a great way to learn how to present data effectively. Be open to collaborate and working as a team. Networking is essential for professional growth.

ChemE Trivia

- The Steam Reforming Process, also known as steam methane reforming (SMR), is the dominant industrial process for the production of hydrogen, using methane (from natural gas) as the feed material. The catalytic reaction of steam and methane was first reported in 1924 by Neumann and Jacob, and the process was later developed in the 20th century for large-scale industrial use. Today, it is widely applied in the chemical and energy industries.
- In the early 1930s, industrial chemists discovered that high-temperature reactions between methane and steam in the presence of a catalyst could efficiently produce hydrogen gas. This breakthrough led to the large-scale development of steam reforming technology, which remains the most cost-effective method for hydrogen production today.
- The process involves two main chemical reactions. In the primary reforming step, methane (CH_4) reacts with steam (H_2O) over a nickel-based catalyst at 700–1100°C and moderate pressure to produce hydrogen (H_2) and carbon monoxide (CO). In the secondary water-gas shift reaction, CO reacts with additional steam to form more hydrogen and carbon dioxide (CO_2).
- Steam reforming is the backbone of the ammonia production industry, as hydrogen is a key feedstock for the Haber-Bosch process. It also plays a vital role in petroleum refining and the production of synthetic fuels and chemicals. More recently, it has gained attention as a primary hydrogen source for fuel cell technologies and clean energy applications.
- Without the existence of the Steam Reforming Process, large-scale hydrogen production would be significantly more expensive, limiting its use in industrial and energy applications. Today, hydrogen is essential for refining crude oil, producing fertilizers, and exploring alternative energy solutions.
- However, the process generates significant carbon dioxide, impacting the environment. To address this, chemical engineers are advancing carbon capture and greener hydrogen production. It is our responsibility to innovate sustainable solutions for a cleaner future.

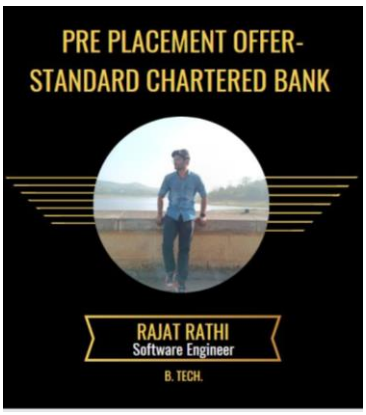
Feature Article

Turbulence in polymer flows

- Turbulence can be experienced in nature daily, be it turbulence felt in an airplane or the disordered flow when a water tap is opened. Turbulence relates to chaotic and disordered flow and is very useful in understanding the mixing of reactors in a reactor, the mixing of air and fuel in an automobile engine, or the flow of water through pipelines. Controlling disordered motion through careful design can save massive operation costs and, hence, is a critical field of research. A striking observation was made when small amounts of polymer were mixed in an otherwise Newtonian solvent. The pressure drop for such flows with small quantities of polymer dropped significantly, thus saving pumping costs. This has led to much research focusing on the effect of adding polymer to water flow through pipes.
- Recent studies show that the instability mechanism in the flow of polymer solutions is very different from that of pure water. Many studies over the last century have demonstrated that Newtonian pipe flow stays laminar or smooth when subjected to sufficiently small disturbances. These flows are said to be 'linearly stable' for minor disturbances. In reality, it is tough for a flow to be subjected to minimal disturbances, and thus, in fact, the flow through the pipe becomes chaotic at reasonable flow speeds. In contrast to pure water, it has been theoretically proved that the flow of polymer solutions through pipes and channels becomes turbulent even when subjected to minimal disturbances. Experiments show that the flow of polymer solution destabilizes at very low flow speeds if the polymer concentration is beyond a threshold limit.
- With such an interesting effect on turbulence in water flow through pipes, polymer flow instability is a fascinating area of fluid dynamics research. A lot remains unexplored in understanding polymer flow instability mechanisms. With more intriguing work in this field, it is expected to tremendously affect how we comprehend turbulence and use it to save energy and enhance engineering design.

PROF. BIDHAN CHANDRA

Placements

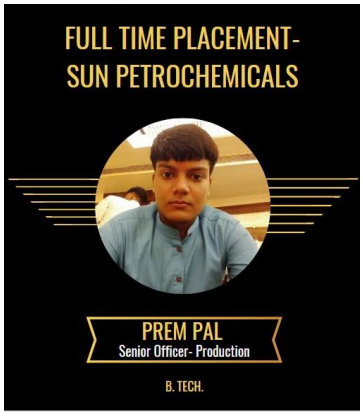

PRE PLACEMENT OFFER-
STANDARD CHARTERED BANK
RAJAT RATHI
Software Engineer
B. TECH.


FULL TIME PLACEMENT-
ACCENTURE SOLUTIONS
DIPTI MEENA
MC Delivery Associate
B. TECH.


PRE PLACEMENT OFFER-
WALMART GLOBAL TECH INDIA
YATHARTH SHARMA
Software Engineer
B. TECH.


FULL TIME PLACEMENT-MEESHO
SANYA SINGH
Senior Associate - Non-Tech
B. TECH.
SATVIK ASTHANA
Senior Associate - Non-Tech
B. TECH.
SPRIHA GHOSH
Senior Associate - Non-Tech
B. TECH.


PRE PLACEMENT OFFER-
AXXELA ADVISORY SERVICES LLP
DARPAN KRISHANIA
Trainee Analyst
B. TECH.
NAVJOT SINGH
Trainee Analyst
B. TECH.

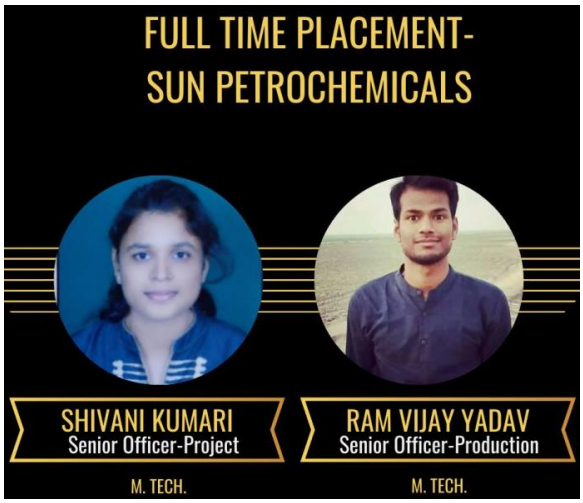

FULL TIME PLACEMENT-
SUN PETROCHEMICALS
PREM PAL
Senior Officer- Production
B. TECH.

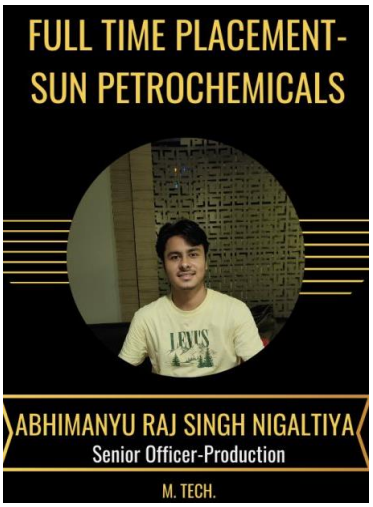

FULL TIME PLACEMENT-
DCM SHRIRAM
DARSHAN DURAI M
TMT – Technical Management Trainee
B. TECH.


PRE PLACEMENT OFFER-
MICROSOFT
MEDHA MISHRA
Software Engineer
B. TECH.


FULL TIME PLACEMENT-
RELIANCE INDUSTRIES LIMITED E & P
PRANJAL MAURYA
Graduate Engineer Trainee (GET)
B. TECH.
SANCHIT TIWARI
Graduate Engineer Trainee (GET)
B. TECH.
CHANDRASEKHAR MOTHUKURU
Graduate Engineer Trainee (GET)
B. TECH.


FULL TIME PLACEMENT-
SUN PETROCHEMICALS
CITRAVEER SINGH
Senior Officer-Production
M. TECH.
KUNAL ASHOK MARATHE
Senior Officer-Project
M. TECH.





Guest Lecture

An enlightening guest lecture was organised by the Chemical Engineering Society, IIT (ISM) Dhanbad, in the Conference Room of the Department of Chemical Engineering, IIT (ISM) Dhanbad on 25 January 2025. The guest lecture, on "Design, Thinking, and Digital Innovation", was delivered by Shri. T. Ganeswara Rao, Chief Technical Services Manager at Barauni Refinery, Refineries Division, Indian Oil Corporation Limited.

The interactive session covered diverse career opportunities in core chemical engineering sector, along with valuable insights into digital innovation, from a seasoned chemical engineering professional with over 20 years of industrial experience. For students, it served as an invaluable opportunity to gain practical knowledge, and engage with an expert from the industry.

Editorial Board