



Department of Chemical Engineering
National Institute of Technology Rourkela

CHEMICAL FLOCS

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Message from the Head



It is my pleasure to present the first issue of *Chemical Flocs*, the newsletter of the Department of Chemical Engineering, NIT Rourkela. This newsletter highlights the department's academic, research, and outreach activities over the year.

The year has been particularly enriching for the department, marked by significant achievements in research, consultancy, and academic activities. Our faculty members continue to contribute to research across diverse domains of chemical engineering, as evident from the impressive portfolio of high-quality journal publications, sponsored projects, patents, and consultancy assignments highlighted in this issue. These achievements reflect the department's commitment to academic excellence, innovation, and societal relevance.

Equally encouraging is the active engagement of our students in industrial internships, academic projects, competitions, and professional society activities. Their achievements demonstrate the department's emphasis on producing competent and responsible chemical engineers.

The department also successfully organized and participated in several academic and professional events, expert lectures, workshops, and conferences. These initiatives promoted interactions among students, faculty, researchers, and industry professionals. The Academic Audit conducted this year provided valuable feedback, and we are committed to continuously improving our curriculum, infrastructure, and academic practices in line with global standards.

I appreciate the efforts of the faculty, students, alumni, and staff for their continued dedication, and I congratulate the editorial team for bringing out this newsletter. I hope this newsletter offers an insightful glimpse into the dynamic activities of our department and inspires continued excellence in the years ahead.

With best wishes,

Susmita Mishra

Head of the Department

Department of Chemical Engineering

National Institute of Technology Rourkela

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RESEARCH AND CONSULTANCY

Patents & Designs

- ❖ **Rupak Kumar Pattnaik** and **Prof. Sujit Sen** filed a patent titled "*Method of Sustainable Synthesis of Covalent Organic Framework via Organic Acid Deep Eutectic Solvent*" on Dec 29, 2025.
- ❖ A patent titled "System and Method for Real-time Facial and Identity Verification" has been filed by **Somendra Seth**, B. Tech student, and his team on Jul 04, 2025.
- ❖ **Singuru Rajesh** and **Dr. Adhidesh S Kumawat** filed two designs titled "Om-Shaped Three-Electrode Configuration for Electrochemical Sensing Device" and "*Portable casing for electrochemical analysis instrument*" on Nov 18, 2025.

Sponsored Projects

- ❖ **Dr. Shashi Kumar** has been awarded the project titled "*Computational Insights into Non-Sulfonamide Carbonic Anhydrase Inhibitors for Disease-Specific Treatments: A Blueprint for Drug Design Development*" by Anusandhan National Research Foundation (ANRF) on Mar 26, 2025.
- ❖ **Prof. Sujit Sen** has been awarded with prestigious ANRF-Advanced Research Grant (ARG) for project titled "*Development of bio-based terminal cyclic carbonate via CO₂ capture and conversion in a semi-continuous process*", on December 18, 2025.

Consultancy Projects

- ❖ A biodiversity study project funded by JSW energy has been completed by **Prof. A. Sahoo** (PI) and **Dr. S. S. Mohapatra** (Co-PI) in 2025
- ❖ **Dr. S.S. Mohapatra** completed four performance evaluation study projects in 2025 funded by Aditya Birla Hindalco Industries Ltd.
- ❖ **Dr. S. S. Mohapatra** and **Prof. A. Sahoo** completed NIPL and performance evaluation projects in 2025 funded by Jindal Steel And Power Limited
- ❖ **Dr. S. S. Mohapatra** completed four projects on performance evaluation of APC and WPC in 2025 funded by NTPC-SAIL Power Company Limited, Seven Star Steel Limited Ferro Alloys Corporation Limited and J. K. Paper Limited
- ❖ **Dr. S. S. Mohapatra** (PI) and **Prof. A. Sahoo** (Co-PI) completed three projects in 2025 on performance evaluation of air and water pollution controlling and monitoring devices funded by Indian Metal & Ferro Alloys Limited, TSM-AEL and Vedanta Ltd.
- ❖ **Dr. S.S. Mohapatra** (PI) and **Dr. A. S. Kumawat** (Co-PI) completed project titled 'Carbon credit study for 2x350 MW TPP' funded by JSW energy in 2025

- ❖ **Dr. S. S. Mohapatra** completed two projects on performance evaluation of pollution controlling equipment from Shiva Cement Limited and Hindalco Industries Limited in 2025.

Journal Publications

- ❖ Akkasali, N.K., Biswas, S., Sen, S., S, A. (2025) Numerical failure load analysis and prediction (ANN technique) of AA2014 adhesively bonded single lap joint: An experimental validation, *International Journal of Adhesion and Adhesives*, 143, art. no. 104157
- ❖ Balakrishnan, A., Chinthala, M., Kumar, A., Barceló, D., & Rtimi, S. (2025). A Z-scheme defect-rich and dimensionally confined double functionalized g-C₃N₄ homojunction pectin hydrogels for the photocatalysis-self-Fenton-peroxymonosulfate system: Unraveling synergistic catalysis and reaction mechanism. *Chemical Engineering Journal*, 503, 158378.
- ❖ Balakrishnan, A., Mathew, F.P., Sebastian Kunnel, E., Varghese, M.M., Trivedi, S., Binoy, M., Chinthala, M., Natarajan, N., Weng, B. (2025) g-C₃N₅-based photocatalysts for energy and environmental applications: insights into properties, structural modifications, challenges, and future directions, *Nanoscale*, 17 (32), pp. 18534 - 18559
- ❖ Balakrishnan, A., Mathew, F.P., Tom Joseph, M., Varghese, M.M., Aryamol, K.S., Chinthala, M., Natarajan, N., Weng, B. (2025) Engineered cellulose-supported photocatalysts for clean energy and environmental remediation: progress and prospects, *Journal of Materials Chemistry A*
- ❖ Balakrishnan, A., Khora, T.K., Devi, K.B., Chinthala, M., Kumar, A., Natarajan, N. (2025) Engineered 3D copper ferrite/kaolinite/polypyrrole carbon black hydrogels for efficient persulfate activation in tetracycline degradation: kinetics, mechanistic insights, toxicity, and green metrics, *Journal of Materials Chemistry A*
- ❖ Balakrishnan, A., Chinthala, M., Kumar, A., Dayanandan, N., & Trivedi, S. (2025). Recent advances on graphitic carbon nitride-based homojunction as effective photocatalysts for energy and environmental remediation. *International Journal of Hydrogen Energy*, 98, 1020-1033.
- ❖ Balakrishnan, A., Kunnel, E. S., Dayanandan, N., Tripathy, H., Chinthala, M., Kumar, A., & Vo, D. V. N. (2025). Photocatalysis-self-Fenton based oxidation system towards the reclamation of recalcitrant pollutants: Current advances and future prospects. *Journal of Environmental Chemical Engineering*, 13, 117171.
- ❖ Chavhan, M. P., Liu, X., Zelenka, T., Arya, S., Das, T., & Boruah, B. D. (2025). Combined effect of hierarchical porosity and surface oxygen functional groups on the performance of carbon xerogels in H₂ storage, CO₂ capture, and Zn-ion hybrid capacitors. *Journal of Energy Storage*, 122, 116712.
- ❖ Dabhade, A.H., Kumawat, A.S., Paramasivan, B., Saha, B. (2025) Hollow rhombic dodecahedron Ag particles decorated electrochemical aptasensor for rapid and onsite detection of E. coli, *Electrochimica Acta*, 542, art. no. 147505

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- ❖ Dahal, H., Soren, S., Kumar, S., & Dey, J. (2025). Unravelling the self-assembly of a novel cationic pseudo-gemini surfactant and its monomeric counterpart: interactions with DNA and BSA in aqueous medium at neutral pH. *Soft Matter*.
- ❖ Damarla, S. K., & Kundu, M. (2025). Novel Hybrid Function Operational Matrices of Fractional Integration: An Application for Solving Multi-Order Fractional Differential Equations. *AppliedMath*, 5(2), 55.
- ❖ Damarla, S.K., Kundu, M. (2025) A Unified Framework Using Orthogonal Hybrid Functions for Solving Linear and Nonlinear Fractional Differential Systems, *AppliedMath*, 5 (4), art. no. 153
- ❖ Das, T., Gangwar, A., Shaw, S. K., Meena, S. S., Verma, M. K., & Verma, B. (2025). Frequency responsive bimetallic oxides as potential supercapacitors electrode. *Inorganic Chemistry Communications*, 114875.
- ❖ Debnath, A., & Das, C. K. (2025). Molecular dynamics investigation of heteroepitaxial growth of quaternary AlInGaN on wurtzite-GaN surface along [0001] direction. *Journal of Vacuum Science & Technology A*, 43(1).
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- ❖ Ghosh, S., Paria, S. (2025) N-Doped Carbon Dots as a Fluorescent Probe for the Detection of Vitamin D, *ACS Applied Nano Materials*, 8 (47), pp. 22750 - 22763
- ❖ Jha, P., & Sen, S. (2025). Sustainable valorization of sour gas: Optimized synthesis of Bis-(p-chlorobenzyl) sulfide using liquid-liquid-solid catalysis. *Journal of Industrial and Engineering Chemistry*. (In Press).
- ❖ Khuntia, A., Kundu, M., Mahapatra, K. (2025) Electrochemical sensor development for detecting organophosphate pesticide using CuO nanograss electrode, *Canadian Journal of Chemical Engineering*, 103 (1), pp. 251 - 263
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- ❖ Kumar, A., Jena, H. M., & Gangawane, K. M. (2025). Iron oxide nanoparticles as efficient adsorbents for malachite green dye removal: Isotherms, kinetics, and thermodynamics analysis. *Environmental Science and Pollution Research*, 1-17.
- ❖ Kumar, A., Gangawane, K. M., & Jena, H. M. (2025). Variations in magnetic behaviour of ferrimagnetic nanoparticles with temperature. *Indian Chemical Engineer*, 1-10.
- ❖ Kumar, D., & Sahu, A. K. (2025). Convective heat transfer from a rotating elliptic cylinder to non-Newtonian fluid in laminar flow condition. *International Journal of Heat and Fluid Flow*, 110097.

- ❖ Kumar, P., & Kumawat, A. S. (2025). Evaluating facile electrode designs of nickel for efficient glucose monitoring. *Ionics*, 31(6), 6365-6375.
- ❖ Minz, P., Mishra, S. (2025) Jackfruit peel derived ZnCl₂-impregnated activated carbon: Optimization, characterization, and application in dye removal, *Biomass Conversion and Biorefinery*, 15 (17), pp. 23879 - 23896
- ❖ Pandey, V. K., Kumar, A., Verma, S., Das, T., Pandey, S. K., & Verma, B. (2025). ZnO Nanoparticles Synthesized by the Solution Combustion Method for Supercapacitor Applications. *ChemistrySelect*, 10(14), e202500598.
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- ❖ Pattnaik, S., Mathur, B., Desai, A., Patel, A., & Chowdhury, P. (2025). Biodiesel production from non-edible castor and sesame oils via homogeneous transesterification: comparative physico-chemical evaluation. *Chemical Papers*, 79(6), 3951-3961.
- ❖ Prabhakar, M.R., Rajesh, S., Kumawat, A.S., Balasubramanian, P. (2025) Harnessing waste paper for energy storage: a comparative analysis of cellulosic supercapacitors, *Journal of Material Cycles and Waste Management*, 27 (6), pp. 4603 - 4613
- ❖ Rai, G., Kurapati, R., & Natarajan, U. (2025). Molecular dynamics simulation study of water dynamics around synthetic polymer chain in aqueous solution: stereo-regular poly (acrylic acid) and poly (methacrylic acid). *Molecular Simulation*, 51(3), 165-178.
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- ❖ Rout, D.R., Jena, H.M., Kumar, A., Baigenzhenov, O., Hosseini-Bandegharaei, A. (2025) Graphene-, GO-, and rGO-supported photocatalysts for degradation of organic pollutants: A comprehensive review, *Environmental Technology and Innovation*, 40, art. no. 104560

- ❖ Routa, C., Sahu, A.K. (2025) Effect of topographical pattern on vortex shedding and heat transfer phenomena in power-law fluid flow around a rotating cylinder, *Numerical Heat Transfer; Part A: Applications*, 86 (16), pp. 5757 - 5778
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- ❖ Sahoo, A., Mishra, S. (2025) Synthesis of microporous-activated carbon via direct H₃PO₄ and KOH activation of Pterospermum acerifolium fruits: process optimization and characterization, *Biomass Conversion and Biorefinery*, 15 (17), pp. 23911 - 23927
- ❖ Shah, Y., Maharana, M., Sen, S. (2025) Peltophorum pterocarpum leaf extract mediated green synthesis of novel iron oxide particles for application in photocatalytic and catalytic removal of organic pollutants, *Biomass Conversion and Biorefinery*, 15 (22), pp. 28431 - 28444
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- ❖ Sinha, V.K., Das, C.K. (2025) Free energy analysis of solid-liquid coexistence in water under superhydrophilic confinement, *Journal of Molecular Liquids*, 435, art. no. 128163
- ❖ Sivaraman, V., Kurapati, R., & Natarajan, U. (2025). Solvation-free energy of uncharged and charged water-soluble synthetic polymer using adaptive Poisson-Boltzmann solver: poly (acrylic acid). *Molecular Simulation*, 51(1), 12-21.
- ❖ Suryaa, K. V., Balakrishnan, A., Chinthala, M., Devi, K. B., Tripathy, H., Kumar, A., ... & Rtimi, S. (2025). Photocatalytic self-Fenton degradation of tetracycline over Z-scheme functionalized g-C₃N₄/CeO₂/Bi₂S₃ hydrogel beads: Dynamics, mechanism, degradation pathways and toxicity analysis. *Chemical Engineering Journal*, 505, 159470.
- ❖ Suryavanshi, V. R., Santhosh, R., Singhi, H., Thakur, R., Ahmed, J., Gaikwad, K. K., Kumawat, A. S., Roy, S., & Sarkar, P. (2025). Preparation and characterization of kodo millet starch/gum tragacanth/copper oxide nanoparticles-based antimicrobial food packaging films. *Materials Today Communications*, 42, 111443.
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- ❖ Tiwari, A., Rao, C. S., Jammula, K., Balasubramanian, P., & Chinthala, M. (2025). Kinetic analysis and machine learning insights in the production of biochar from *Artocarpus heterophyllus* (jackfruit) through pyrolysis. *Biomass and Bioenergy*, 201, 108125.
- ❖ Tiwari, A., Chinthala, M. (2025) Tea waste to biochar: A comparative analysis of conventional and microwave-assisted pyrolysis methods, *Journal of Analytical and Applied Pyrolysis*, 192, art. no. 107320
- ❖ Tripathy, H., Balakrishnan, A., Chinthala, M., & Kumar, A. (2025). Peroxymonosulfate-activated photocatalytic reclamation of sulfamethoxazole using $\text{In}_2\text{S}_3/\text{CuSe}$ infused carboxymethyl cellulose photocatalytic heterojunction hydrogels: Insights into operations and mechanisms. *Chemical Engineering Journal*, 164360.
- ❖ Verma, S., Das, T., Verma, S., Pandey, V. K., Pandey, S. K., Verma, H., & Verma, B. (2025). Hierarchically architecture of Ru-doped multichannel carbon nanotubes embedded with graphene oxide for supercapacitor material with long-term cyclic stability. *Fuel*, 381, 133517.
- ❖ Vijaya Suryaa, K., Balakrishnan, A., Chinthala, M., Bidya Devi, K., Tripathy, H., Kumar, A., Aminabhavi, T.M., Rtimi, S. (2025) Photocatalytic self-Fenton degradation of tetracycline over Z-scheme functionalized g-C₃N₄/CeO₂/Bi₂S₃ hydrogel beads: Dynamics, mechanism, degradation pathways and toxicity analysis, *Chemical Engineering Journal*, 505, art. no. 159470
- ❖ Yu, W., Kumar, S., Zhao, M., Weber, D. J., & MacKerell Jr, A. D. (2025). High-Throughput Ligand Dissociation Kinetics Predictions Using Site Identification by Ligand Competitive Saturation. *Journal of Chemical Theory and Computation*, 21(9), 4964-4978.
- ❖ Thomas, A., Paria, S. (2025) Cu₂O@rGO Nanocomposite for Dual Photocatalytic and Sensing Applications, *Industrial and Engineering Chemistry Research*, 64 (44), pp. 21062 - 21073

Books and Book Chapters

- ❖ Pal, D. and Sen, S. (2025) Circularity and Sustainable Economy Model Towards Supply Chain Management and Zero Waste, *Environmental Science and Engineering*, Part F218, pp. 353 - 383
- ❖ Pal, D. and Sen, S. (2025) Sustainable Technologies in the Development of Novel Processes and Products from Environmental Hydrocarbon Pollutants, *Environmental Science and Engineering*, Part F218, pp. 201 – 240
- ❖ Pal, D. and Sen, S. (2025). Innovative Treatment Options for the Removal of Emerging Pollutants from Wastewater. In: Dey, S., Shah, M.P. (eds) *Biotechnological Removal of Emerging Pollutants from Wastewater Systems*. *Advances in Wastewater Research*. Springer, Singapore

Jena, H.M., Gangawane, K.M. (2025), Enhanced thermal energy storage with biopolymer-based organic materials, pp. 219 – 243

- ❖ Pal, D. and Sen, S. (2025). Toxicity and Health Impacts of Emerging Pollutants. In: Dey, S., Bhattacharya, S. (eds) Biotechnological Interventions in the Removal of Emerging Pollutants. Interdisciplinary Biotechnological Advances. Springer, Singapore.
- ❖ Kumar, A., Jena, H.M., Gangawane, K.M. (2025), Biopolymer-based composites for enhanced oil recovery in sustainable energy generation, pp. 301 – 314

Conference Publications

- ❖ Adhirajan, A., Pankhedkar, N., Patel, R., Sahoo, A., Dwivedi, A., Gudi, R. (2025) Modelling and Optimization of an intensified water electrolysis integrated tri-reforming coupled methanol production process DOI: 10.1051/e3sconf/202564803003, E3S Web of Conferences, 648, art. no. 03003
- ❖ Kashyap, M., Karua, C.S., Sahoo, A.K. (2025) Modeling of Permeate Flux for Cross-Flow Ultra-Filtration Membrane by ANN and ANFIS Approach, Lecture Notes in Civil Engineering, 581, pp. 31 - 55

Honors and Recognition

- ❖ **Prof. Sujit Sen** was appointed as a Subject Expert Committee (SEC) Member of the PM-ECRG Scheme, ANRF, Government of India in 2025.
- ❖ **Prof. Sujit Sen** was appointed as a Member of the NPDF Evaluation Committee (Engineering Sciences), ANRF, Government of India.
- ❖ **Prof. Sujit Sen** was nominated as a Member of the Board of Studies for the Department of Chemical Engineering, VSSUT, Burla.
- ❖ **Prof. Sujit Sen** was inducted as an Editorial Board Member of Springer Nature.
- ❖ **Singuru Rajesh**, PhD scholar, received Best Presentation Award for his presentation titled '*Evaluation of conductive properties of additively manufactured electrodes (AME) from ABS conductive filament: Influence of pre-treatment and structural analysis*' at the "DAE-BRNS Conference on Electrochemistry for Industry, Health and Environment (EIHE-2025) organized by Indian Society for Electro Analytical Chemistry-ISEAC and BARC in Mumbai during 21st – 25th January 2025.
- ❖ **Singuru Rajesh**, PhD scholar, presented an Invited talk on "*Technology – Driven Social Entrepreneurship*" on 23rd March 2025 in the Youth India Foundation-Ramjas Chapter, Delhi.



- ❖ **Hritankhi Tripathy**, PhD scholar, received Best Paper Award for presentation titled 'Photocatalytic Urea-In₂S₃ hydrogel beads for wastewater treatment followed by nitrogen fixation to plants' at 10th International Conference on Sustainable Energy and Environment Challenges held at IIT Jodhpur during 15-18th December, 2025.



ACADEMICS

Achievements

- ❖ **Subhasmita Tripathy**, BTech student, recognized with a Certificate of Achievement on Jun 29, 2025 during her summer internship at TATA STEEL Kalinganagar for her outstanding contribution in improving operational efficiency by enhancing cooling tower performance and for development of real-time Tableau dashboard to support monitoring and data-driven decision making.



Industrial Visits and Internships

- ❖ **Summer Internship experience at Tata Steel Kalinganagar, Odisha by Subhasmita Tripathy**



I, Subhasmita Tripathy, a final year UG student, completed summer internship at Tata Steel Kalinganagar. I undertook a comprehensive study on the water circuit of the by-product plant and worked on improving the operational efficiency of cooling towers under the guidance of Mr. Gangadhar Hota, senior area manager of by-product plant. I gained extensive exposure to industrial water treatment systems, cooling tower operation, and process optimization. My study focused on key parameters such as cycle of concentration, TDS and pH control to achieve a measurable improvement in system efficiency. I developed an interactive Tableau dashboard for real-time monitoring of water quality KPIs to enhance

process performance within the plant.

- ❖ **Learning chemical engineering at scale: Summer internship experience by Subham Samantaray**



I am Subham Samantaray, a third-year undergraduate student in the Department of Chemical Engineering at NIT Rourkela, and I completed an industrial internship at Indian Farmers Fertiliser Cooperative Limited (IFFCO), Paradeep in June 2025. The internship was a valuable experience that provided both technical exposure and professional insight into large-scale fertilizer manufacturing. During the internship, I gained technical understanding of key process units, particularly the Diammonium Phosphate (DAP) plant and the Sulfuric

Acid plant, where the integration of chemical reactions, energy utilization, and safety systems highlighted the complexity of industrial process operations. Observing these units in operation helped strengthen the connection between theoretical concepts and real-world engineering practice. The experience was further enriched by exposure to IFFCO's innovation-driven initiatives, notably Nano DAP, aimed at improving fertilizer efficiency and sustainability. Preparing a detailed case study on Nano DAP allowed me to reflect on the role of advanced technologies in supporting India's agricultural and industrial progress. Overall, the internship strengthened my technical foundation and reinforced my motivation to pursue responsible and impactful work in the chemical engineering domain.

❖ **Internship experience at Jindal Stainless Limited, Kalinganagar by Subhasmita Tripathy**

I, Subhasmita Tripathy, a final year UG student, completed two projects as internships at Jindal Stainless Limited, Kalinganagar. One project is "Minimization of Pellets Clustering during Pellet Production and Optimisation of Bentonite Usage" under the guidance of Mr. Manoj Kumar Shaw (AVP & Head – Ferroalloys Plant). My work involved analyzing the complete palletization process and identifying the factors responsible for clustering during pellet production. By systematically studying the effect of binder composition, green ball strength, and bentonite dosage, I proposed process improvements that optimized binder utilization and improved pellet quality and uniformity. The other project is on the Optimization of Chemical Usage in DM Water Production within the Captive Power Plant under the guidance of Mr. Pramod Ranjan Dash (AVP – Captive Power Plant). I carried out a comprehensive analysis of the demineralization process, identified key inefficiencies, and implemented strategies to enhance chemical utilization and operational efficiency.



❖ **Summer Internship experience at Reliance Industries Limited (RIL), Vadodara by Aayushman Chandra Gupta**

I am Aayushman Chandra Gupta, a final year UG student in the department of Chemical Engineering, NIT Rourkela. I did my summer internship at Reliance Industries Limited, Manufacturing Division (VMD), Vadodara on project titled "Study on Removal of Heavies in Benzene Plant Feed" under the guidance of Mr. Chirag Prajapati. I explored the complete working of the Benzene Recovery Unit, focusing on the two-stage hydrogenation and distillation process used for extracting aromatics from Pyrolysis Gasoline (PyGas). The study emphasizes the operational challenges arising from the non-functioning of the second rerun column, which previously removed heavier hydrocarbons (C_8+) before the extractive distillation section. Through process observation, data analysis, and simulation-based mass balance, I was able to evaluate the impact of heavies on benzene recovery efficiency and product purity. The project also involved assessing column operating parameters and proposing potential process optimizations to minimize heavy-end interference in the extraction system.



EVENTS

Organized by the Department

❖ Entrepreneurship and Skill Development Program (ESDP) on Energy Storage Materials



The Foundation for Technology & Business Incubation (FTBI), in collaboration with the Department of Chemical Engineering, NIT Rourkela, organized the Entrepreneurship and Skill Development Program (ESDP) on Synthesis, Testing, and Characterization of Energy Storage Materials from March 1-7, 2025. **Dr. Prateek Khatri** and **Dr. Tapas Das** served as convenors of the program sponsored by the Ministry of Micro, Small and Medium Enterprises (MSME), Government of India.

❖ AIChE NIT Rourkela Hosts 'Solvers Arena'



The AIChE NIT Rourkela Student Chapter successfully organized and hosted Solvers Arena, a high-octane technical competition designed to test the analytical, business, and sustainability skills of aspiring engineers. The event provided a unique platform for students to tackle real-world problem statements through a blend of technical knowledge and strategic thinking.

The competition was conducted in two rigorous rounds. Round 1, saw participation from over 20 teams and featured an interactive crossword puzzle focusing on general knowledge and reasoning, followed by an exhilarating buzzer round. From this competitive field, the top six teams qualified for Round 2. In the final stage, these teams presented compelling ideas centered on Sustainability and Innovation, which were assessed by our esteemed Faculty Advisor and judge, Prof. Sujit Sen. Winners were determined through a combination of judge feedback and social media engagement via Instagram votes.

❖ **Confluence of Innovation: AIChE NIT Rourkela at Naimishya 2025**

The AIChE NIT Rourkela Student Chapter proudly participated in the India Student Regional Conference (SRC) 2025, titled "Naimishya," held from August 21 to 24. Hosted by the AIChE ICT-IOCB Student Chapter at the Institute of Chemical Technology – Indian Oil Odisha Campus in Bhubaneswar, the conference brought together over 250 delegates from premier institutions like IITs, NITs, BITS, and VIT. This four-day summit served as a melting pot of academic rigor and industrial foresight, centered on the theme "Pathways to Net Zero."

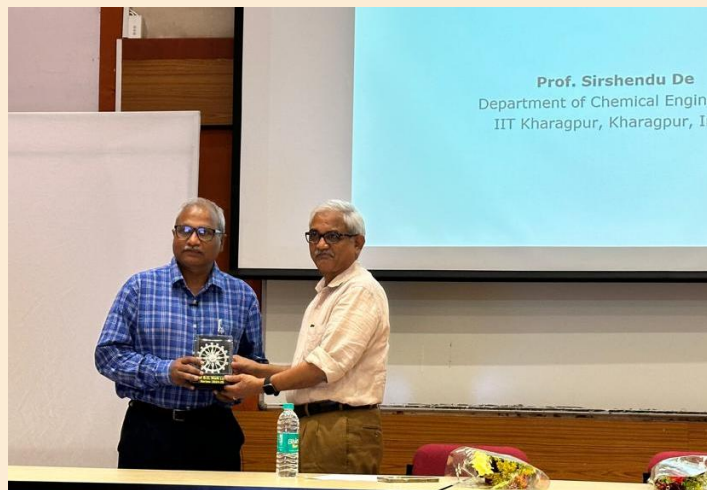
The conference featured a versatile range of competitions that tested both technical depth and creative communication. At the heart of the regional spirit was the Chem-E-Car Competition®, the most celebrated event where teams designed chemically powered vehicles. Other high-stakes events included ChemE Jeopardy, which challenged students' quick-fire knowledge of STEM related concepts, and the Technical Paper and Poster Presentations, showcasing cutting-edge research. The flagship event, VerSUS, demanded high-level technical synergy and process optimization skills from all participants.

Our chapter's dedication culminated in significant victories, most notably securing the 1st Prize in VerSUS. Additionally, Team Supernovae achieved 2nd Prize in the K-12 Outreach Competition, effectively bridging the gap between complex engineering and school-level curiosity. Beyond the accolades, the true takeaway was the invaluable peer-to-peer knowledge sharing and networking with industry dignitaries from Indian Oil and CSIR.

❖ **Prof. Sirshendu De delivered lecture as the speaker of Dr S.C. Nayak Annual Lecture Series**

The department has organized Dr S.C. Nayak Annual Lecture Series on April 20, 2025. The speaker for this year's Lecture Series was Prof. Sirshendu De from IIT Kharagpur. He is renowned for his reputed research papers, patents, and successful implementation of research projects, is also an awardee of the country's highest honour in science, the 'Shanti Swarup Bhatnagar Award'. During his lecture, he shared his extensive research experience in water treatment, particularly in removing arsenic and fluoride from contaminated water. He emphasized the importance of using natural resources and minimal energy to develop sustainable solutions.

The program was inaugurated by the Director, Prof. K. Umamaheshwar Rao and attended by the Head of the Chemical Engineering Department, Prof. Susmita Mishra, along with over 150 students, faculty members and distinguished researchers from across the country and abroad. The event provided an opportunity for high-level intellectual exchange for students.



❖ **Expert lecture by scientist Nagamani from Bureau of Indian Standards (BIS)**

Nagamani T, scientist and director at Bureau of Indian Standards (BIS) delivered expert lecture at the department of Chemical Engineering, NIT Rourkela on Jan 23, 2025. She has over 18 years of experience in product certification and standards formulation and served as Head of the Bengaluru Laboratory, Member Secretary for fuel technical committees, and has been involved in developing national standards for biofuels. She specializes in petroleum products, fuels, and lubricants, serving as a member in national mirror committees for ISO/TC 28. Her lecture was focused on introduction to standards and opportunities with BIS for students and faculty.



❖ **Expert lecture by Dr. P. V. Nidheesh, senior scientist from CSIR- NEERI**

Dr. P. V. Nidheesh, a distinguished scientist from CSIR-NEERI, is recognized for his significant contributions to the field of environmental engineering, particularly in advanced wastewater treatment, resource recovery, and sustainable remediation technologies. He delivered a talk on research opportunities for students at CSIR-NEERI and MoU opportunities for the department on Oct 07, 2025.





❖ **Academic audit 2025**



The Academic Audit 2025 team - Prof. S. Panda from IIT Kanpur, Prof. T. K. Radhakrishnan, NIT Trichy and Dr. S. Mukhopadhyay from BARC Mumbai, visited the Department on Apr 3, 2025. During the visit, the team interacted with the Head of the Department, faculty members, students, and supporting staff. Detailed discussions were held on curriculum design and delivery, attainment of course outcomes and program outcomes, assessment methods, research and

consultancy activities, faculty development initiatives, infrastructure and laboratory facilities, and student support systems. The team also visited classrooms, laboratories, and other departmental facilities to assess the adequacy and effective utilization of academic resources. The Department appreciated feedback and suggestions were provided by the Audit Team and appropriate measures would be taken to implement them.

❖ **Short-term course on Molecular Simulation for Chemical and Biomolecular Systems**



The department organized a five-day online Short-Term Course titled “Molecular Simulations for Chemical and Biomolecular Systems (MoSiC–2025)” from December 08–12, 2025. A total of 53 participants, including students, research scholars, and faculty members from across the country, registered for the course. The course covered the fundamentals of statistical mechanics, molecular dynamics (MD), and free energy calculations, complemented by hands-on training using widely used tools such as Avogadro, Packmol, Ovito, VMD, NAMD, and LAMMPS. Dr. Ravi Kumar Reddy Addula and Dr. Raviteja Kurapati served as the Convenor, and Co-Convenor for the course.

Participation from the Department

- ❖ **Dr. Prateek Khatri** from the Chemical Engineering Department served as a member of the organizing committee for the International Conference on “Recent Innovation and Development in Science and Engineering Fields (RIDSEF-2025)” organized by The Central Research Facility, NIT Rourkela during March 5-6, 2025.
- ❖ **Prof. Sujit Sen** delivered invited talk on “A cradle-to-cradle methodology to treat industrial wastewater using industrial waste-derived materials” for 2nd International Conference on Advances in Energy and Environment for Sustainable Development (AEESD-2025), March 28-29, 2025, jointly organized by Siksha ‘O’ Anusandhan (Deemed to be University), Odisha; Doon University, Uttarakhand; and CSIR-IMMT, Bhubaneswar, Odisha, India.

- ❖ **Prof. Sujit Sen** nominated as resource person and distinguished speaker from Institute for one-day workshop on "*Innovation & IPR for sustainable development*" held on October 28, 2025, at CSIR-IIMT Bhubaneswar, joint workshop of CSIR-IIMT with NIT Rourkela.
- ❖ **Prof. Sujit Sen** served as resource person in for online Faculty Development Programme (FDP) on "Empowering Mechanical Engineering research through innovation and IP awareness" organized by Department of Mechanical Engineering at Institute of Engineering & Management, Kolkata from 8-12, December 2025,
- ❖ **Dr. Kshetramohan Sahoo** presented a poster titled "*Carbon Dioxide Capture by Adsorption: Where is the Limit?*" at the India-Singapore Bilateral Workshop on *Advanced Materials for Energy and Environment (AME2)* held at IIT Kharagpur from February 24-26, 2025.
- ❖ **Dr. Shashi Kumar** participated in India-Singapore Bilateral Workshop on "*Advanced Materials for Energy and Environment (AME²)*" under the SPARC programme held at IIT Kharagpur from 24-26 February 2025.
- ❖ **Dr. Kshetramohan Sahoo** participated in a five-day *Science Communication Workshop* under the Deen Dayal Upadhyaya Teacher Training Programme held at IIT Hyderabad from March 1-5, 2025.
- ❖ **Dr. Kshetramohan Sahoo** attended a one-day workshop on "*Transport Processes in Electrochemical Systems*" held at IIT Kharagpur on March 7, 2025.
- ❖ **Dr. Raviteja Kurapati** and **Dr. Chandan Kumar Das** attended a 10-day online Faculty Development Program (FDP) on the topic *Advanced Nanoscale Materials for Sustainable Electronics & Energy* organized by KLH Bachupally in association with NIT Warangal and IIITDM Kurnool during Feb 17-26, 2025.
- ❖ **Khwairakpam Bidya Devi**, PhD scholar, participated in ANRF sponsored two day workshop in *Advanced Oxidation Processes for Mitigating Recalcitrant Contaminants in Waste Water (AOPMRC-2025)*.
- ❖ **Udita Dey**, MTech student, completed workshop "*AI for Students: Build Your Own Generative AI Model*" conducted by NxtWave Disruptive Technologies in December, 2025.
- ❖ **Udita Dey**, participated in a 5-day *India-Austria Workshop on Advanced Enzymatic Bioprocesses for Sustainable Biorefineries* organized jointly by Department of Biotechnology IIT Hyderabad and Department of Biotechnology and Medical Engineering (BM) NIT Rourkela during 8-12 December, 2025
- ❖ **Udita Dey**, participated in the *National Bioengineering Conference 2025* organized by the Department of Biotechnology and Medical Engineering NIT Rourkela from 11-13th December, 2025.

- ❖ **Udita Dey**, completed in-person course on *Rotating Machinery Bootcamp: Compressors and Pump* conducted by Centre for Continuing Education, IISc Bengaluru at NIT Rourkela from 4-6th September, 2025.
- ❖ **Aman Tiwari**, BTech student, presented a poster encapsulating his research project on the *utilization of Pickering Emulsion for multiphase reactions* at the India-Singapore Bilateral Workshop on *Advanced Materials for Energy and Environment (AME2)* held at IIT Kharagpur from February 24-26, 2025.
- ❖ **Aniket Nayak**, BTech student, showcased outstanding performance at Azeotropy 2024 and Azeotropy 2025, the prestigious annual Chemical Engineering fest of IIT Bombay. He won prizes in three events - AzeoCube, Industrial Design Problem and Chempreneur (a startup competition).
- ❖ **Aditya Kumar Ray**, BTech student, and his team from the Cyborg Club (Robotics and Automation Club of NIT Rourkela) has triumphed at the prestigious Robofest Gujarat 4.0, securing the First Prize in the Maze Solving Category. This achievement brought home a total prize money of ₹12.5 lakhs.

ARTICLES

Decentralized and Networked Processes for Sustainable Growth

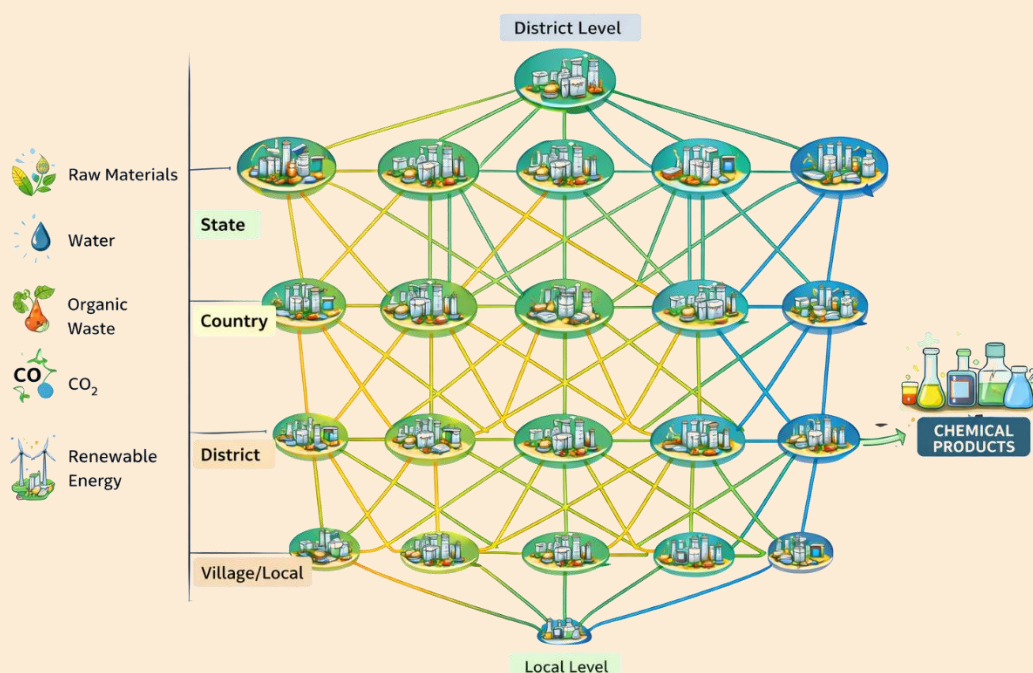
A process is transformation of an input into output. These inputs or outputs could be materials, energy or information. A process can itself be a sequence of different processes arranged in a sequence to achieve desired transformation. It means a big transformation can be brought about by integrating small transformation. The ordered sequence of small transformations that connects the initial state (input) to the final state (output) can be referred as the path. The same overall transformation in the inputs can be achieved through multiple distinct paths. Diversity in paths with unity in goals is a well-accepted and foundational principle of Indian philosophy. *Ekam Sat, Viprā Bahudhā Vadanti* - Truth is One, the wise speak of it in many ways. Given the opportunity to play in the random experiment of choosing the path, the choice is rarely unconstrained. We constrain the process or path to sustainability (*dharma*), cost (*artha*), ease of operation (*kama*) and efficiency. In this article, I like to share few thoughts on how decentralized networked processes are optimal for a given change.

We know from second law of thermodynamics that a reversible process is the most efficient process. It is realized through an infinite sequence of differential changes. Thus a sequence of small coordinated transformations is closer to reversible process. If the efficiency is computed taking the path into consideration, a highly centralized process that attempts to achieve a large transformation in a single step is inherently less efficient than a distributed set of smaller transformations coordinated through a network. A Plug Flow Reactor (PFR) is more efficient than a Continuous Stirred Tank Reactor (CSTR) for the same reaction, volume, and feed conditions. A student who studies daily and earns a good grade is more efficient than a student who earns the same grade by cramming just before the exam. Highly irreversible learning produces unstable knowledge. What is acquired rapidly is also lost rapidly. Distributed processes minimize the losses and retain the desired change for long duration.

Efficiency improves not only when processes are distributed but also when they are networked. A process is truly efficient only when its output can seamlessly serve as an input to another process. A chemical process is more efficient when its effluents can be assimilated by environment, its by-products can serve as inputs to other processes, and its energy outputs can be recovered and reused. Learning process is fruitful when it is discussed with peers and when individuals help one another in understanding and applying concepts. When knowledge circulates through discussion, collaboration, and mutual explanation, it becomes more effective. When shared or networked (*saha nau*), we are protected (*avatu*) and nourished (*bhunaktu*), we work with vigor and our learning (*adhitam*) become more useful and radiant (*tejasvi*).

We know from the principles of transport phenomena that the transfer rate scales with interfacial area. Nanotechnology demonstrates that reducing system size dramatically increases surface area to volume ratio. Thus, distributed systems enhances networking by increasing interfaces and achieves higher effectiveness and responsiveness. One might expect that increasing the transfer area would lead to greater losses, but in reality, the losses remain minimal because the driving force per unit area decreases. Learning becomes effective when teacher and student engage closely at the intellectual level.

Even in machine learning, the learning is distributed between nodes which are interconnected in layers. The artificial intelligence emerged from distributed and interconnected units and not from a single central unit. Distributed and networked systems are widely adopted in IT companies such as e-commerce companies, micro services architecture and service sector companies such as banks and hospitals. I encourage the readers to think of such a network type design in chemical manufacturing.



Why distributed networked systems are advantageous over centralized systems?

- **Reliability:** In a centralized system, everything stops if central unit fails whereas failure is localized and not catastrophic in distributed system.
- **Scalability:** Centralized systems scale by enlargement whereas distributed systems scale by addition rather than modification.
- **Innovation and Feedback:** Centralized systems are slow in learning and feedback whereas distributed systems are faster in innovation and learning.

While distributed and networked systems are good for growth and learning, these are limited of several practical reasons:

- *Control*: Distributed systems are harder to control due to complexity in co-ordination and control structure
- *Delay, cost and noise* in communication within the network
- *Diagnosis of failure* is hard

Ancient Indian manufacturing was predominantly distributed, networked, and decentralized. The distributed manufacturing was systematically dismantled, not outcompeted. The manufacturing during that period was not able to compete the standardization and scaling by machines and centralized energy sources. The demand for standardized, machine-made products in India was created externally, not organically generated within Indian society. Though demand appears internalized, it is rarely neutral. Even today, from food choices to career aspirations, preferences are shaped by institutions, incentives, and narratives. What we call demand is often the outcome of a forced system, not an expression of free choice.

The encouragement for entrepreneurship under self-reliant India (*Atmanirbhar Bharat*) is best realized not by enlarging individual enterprises, but by enabling startups to scale through networking. Mapping industries across sectors—including handicrafts, agro-processing, and building materials—and integrating them through supply-chain networks reduces destructive competition, enhances complementarity, and protects small-scale producers while preserving their autonomy.

by

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ALUMNI CONNECT

Please introduce yourself

I am *Prajakta Nanda*, born and brought up in Rourkela, Odisha. I graduated from National Institute of Technology, Rourkela in the year 2025, where I earned a Bachelor's degree in Chemical Engineering with a minor in Electrical Engineering. I was honored with the Prof. S. C. Nayak Gold Medal for being the best graduate in Chemical Engineering and the branch topper medal for achieving the highest CGPA in the department. Currently, I am working as a Software Engineer at Microsoft in Hyderabad.



Looking back, what do you miss the most about your college days?

During my time in college, I maintained a balance between academics and extracurricular pursuits. I spent my mornings attending classes, taking notes, and engaging in discussions with my professors, while my afternoons were often devoted to a variety of activities beyond the classroom. What I miss most are the unhurried mornings, the joy of learning in classrooms and labs, and the spontaneous moments during extracurricular sessions that allowed me to build meaningful connections with both faculty and friends. I also fondly remember the college fests—three-day celebrations that offered a refreshing escape from routine and created some of the most memorable experiences of my college life.

How did it feel transitioning from student life to a full time job?

The transition from student life to a full-time professional role was both challenging and transformative. In college, my days were structured around classes and activities, with ample time to spend with friends and explore personal interests. Entering the corporate world, however, meant taking full ownership of my time and responsibilities. Balancing professional commitments with everyday essentials—maintaining a healthy routine, ensuring regular meals, and prioritizing sufficient rest—required a new level of discipline and self-management. Over time, this shift helped me grow more independent and resilient, shaping a more structured and purposeful approach to daily life.

How did you secure your current job? What was the most challenging part?

I began my journey by securing an off-campus internship at Microsoft, which later culminated in a pre-placement offer upon successful completion of the program. Coming from a non-circuitual and non-technical academic background, the most challenging aspect was breaking into the software domain. Many companies had eligibility restrictions that limited my ability to apply, which meant I had to consistently upskill, stay resilient, and prepare thoroughly to make the most of every opportunity that came my way. Clearing online assessments and navigating technical interviews required focused effort and perseverance, but the experience ultimately strengthened my confidence and problem-solving abilities.

Which skills or concepts from UG are most useful in your current job? What skills did you realize were missing when you started working?

One of the most influential subjects during my undergraduate studies was Chemical Engineering Mathematics, which introduced me to foundational concepts in machine learning and sparked my interest in the software and development domain. That exposure motivated me to explore the field more deeply and ultimately shaped my career path.

When I began working, I realized that while my academic training had prepared me well conceptually, I needed to develop a stronger understanding of how large-scale technology organizations operate in practice. Navigating complex infrastructure and codebases, as well as creating and maintaining clear technical documentation, were skills I had to build over time. With guidance from senior colleagues and hands-on experience, I gradually became more comfortable working within these systems and collaborating effectively in a professional engineering environment.

What was your first responsibility at work? What kind of training did your company provide?

As a Software Engineer, I am part of the OneDrive and SharePoint organization. My first major responsibility involved working with production databases to analyze user behavior and streamline data, helping reduce the load on our services and infrastructure while improving overall efficiency and ensuring a consistent user experience. To support new hires, Microsoft provided a well-structured onboarding program that included workshops, guided learning sessions, and interactive Q&A forums to ease the transition into the corporate environment. We also had opportunities to engage with leaders who shared insights on presenting our work effectively, taking ownership of our projects, and creating meaningful impact. In addition, team-specific onboarding helped us understand our organization's role, our team's objectives, and how our work directly influences customers and users in real-world scenarios.

Did any academic projects, lab courses, internships or other sources help you directly in securing your current job? What are they?

A combination of academic preparation, internships, and co-curricular involvement contributed directly to securing my current role. Alongside an off-campus internship at Microsoft, I also completed an on-campus internship with Trident, a core chemical engineering organization, where I applied key concepts from subjects such as mass transfer, heat transfer, and chemical reaction engineering. Maintaining a CGPA above 8.5 during this period reflected my academic consistency and subject proficiency, which supported my shortlisting during the recruitment process.

My summer internship at Microsoft proved especially pivotal, as it laid the foundation for my current position and offered valuable exposure to real-world software development practices. In parallel, I actively participated in online coding competitions, programming clubs, and hackathons, including being the finalist at the Smart India Hackathon (SIH), which strengthened my problem-solving and collaborative skills. Additionally, lab courses such as Computer-Aided Design and Computational Fluid Dynamics introduced

me to coding-intensive applications, helping me develop logical thinking and technical versatility that continue to benefit me in my professional role.

One thing you wish you had done more seriously during college?

Looking back, I wish I had dedicated even more time to consistent problem-solving and skill development. While my college experience was enriching in many ways, spending additional time exploring new tools, deepening my technical abilities, and challenging myself with diverse problems would have further strengthened my foundation and accelerated my growth.

What skills are you currently working on improving?

With the rapid growth of the AI domain, I am currently focused on strengthening my understanding of artificial intelligence alongside building expertise in designing and scaling large-scale infrastructure and services. These efforts help me create more impactful, reliable, and meaningful experiences for users while continuing to grow as an engineer.

What advice would you give your 'final-semester-self'?

I would remind my final-semester self to strike a balance between academic focus and exploration. While dedicating time to coursework is important, stepping beyond one's comfort zone to discover new domains can open unexpected opportunities. I would also encourage spending more time with professors and friends, as the relationships and networks built in college are truly unique and lasting. Most importantly, I would say to embrace the journey—learn from every setback, lean on the support of those around you, and make the most of the experience, because college life is a once-in-a-lifetime chapter.

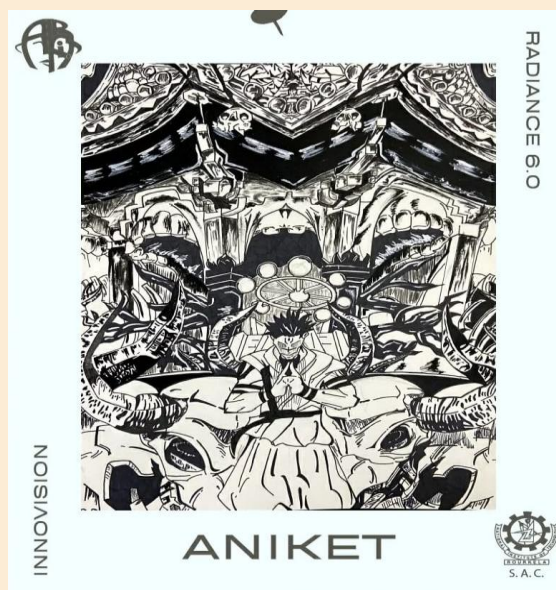
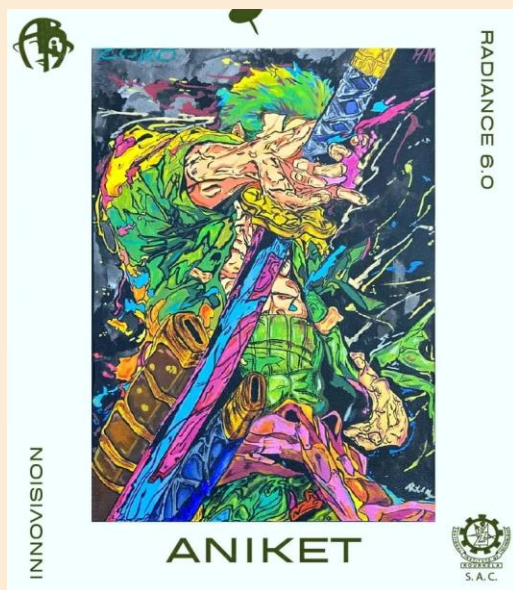
Any message you want to give to juniors who are anxious about placements?

To anyone feeling anxious about placements, know that you are not alone—I once stood in the same place. Balancing academics with preparation can be challenging, but believing in yourself and staying consistent, even during difficult moments, makes a meaningful difference. Seek guidance from your professors; their experience and perspective can help you recognize your strengths and refine your approach. Staying attentive in class and building strong fundamentals will support both your academic performance and your career goals.

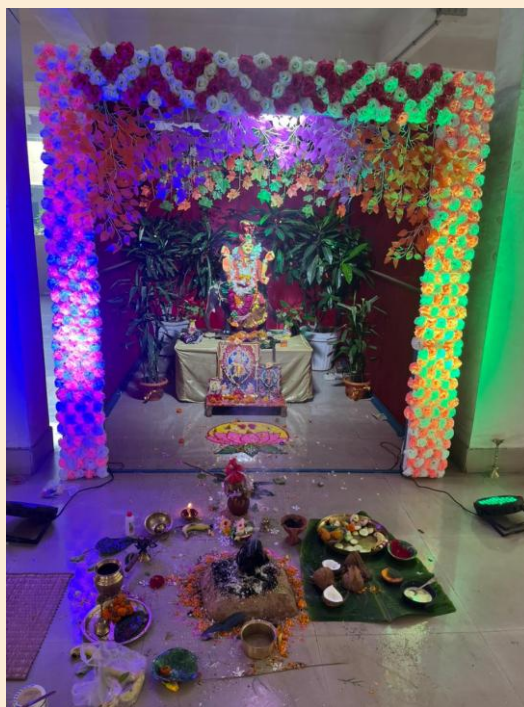
If you are aiming for opportunities within your core domain, focus on mastering your concepts and applying them with confidence. If you are exploring paths beyond your major, invest in continuously upgrading your skills—because practical abilities often open doors where formal eligibility does not. Above all, have faith in your journey, remain resilient, and keep working toward your goals with determination and optimism.

EXTRACURRICULAR ACTIVITIES

- ❖ **Aniket Nayak**, Btech student, participated in Radiance 6.0, NIT Rourkela. Here are two of his best paintings from the exhibition.



- ❖ Bishwakarma Puja Celebration on Sep 17, 2025



❖ Teacher's day celebrations 2025



Note from Editorial Team

Chemical Flocs is a collective effort to showcase the academic, research, and extracurricular activities of our department. We hope this edition provides an overview of our departmental progress and achievements.

We sincerely invite your feedback, suggestions, and contributions for upcoming issues. Kindly share your feedback at: kurapatir@nitrkl.ac.in

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