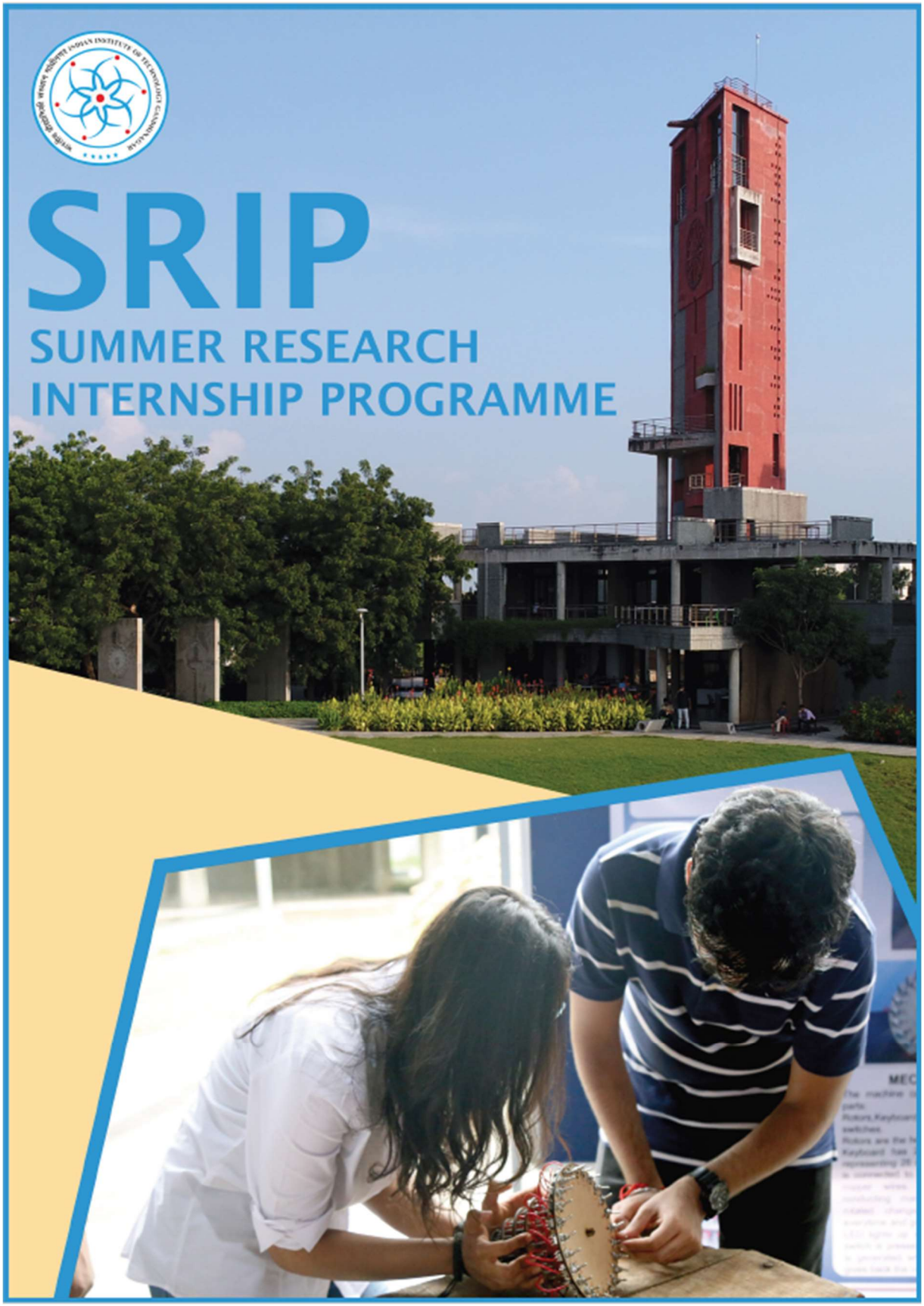

SRIP Report 2024

May – July 2024

Team

Prof. Abinaya Sampath
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Background

The Summer Research Internship Program (SRIP) started as an initiative aimed at increasing the visibility of the Institute and presenting its attractive environment to a large audience. As part of SRIP during the summer months, the Institute offers specific research projects for students from all over India to participate in. The Institute supports the students by providing a stipend and hostel accommodation. The program was started in 2011 and was limited to the state of Gujarat in the first edition. The second edition of the program in 2012 attracted nearly 700 applications from all over the country for 12 research projects. Thirty-five students were selected from among the applicants and spent between two to three months at IIT Gandhinagar working on their research projects of interest. An online application system was used in the third edition of the program in 2013, and an unprecedented number of nearly 5000 applications were received for 35 research projects. Eventually, 45 students were selected for these projects based on several parameters such as academic background, profile and area of research interest.

The SRIP 2024 is the thirteenth edition of the Summer Research Internship Program at IIT Gandhinagar. The SRIP Portal was used for online application submission, and the students were invited from across the country to make it to the program following a very competitive selection process. We received an overwhelming 75906 applications for 134 projects floated (by 67 faculty members). A total of 176 interns joined the institute out of which 63 are from IIT Gandhinagar. At IIT Gandhinagar, the interns from other institutes are treated at par with the internal students. The institute provides them with a great research experience and also encourages them to participate in other activities such as sports and cultural events. Many of them have had a significant impact on their career because of participation in this program.

Students from prominent institutions across India have participated in SRIP since its inception. These include other IITs, notably IIT Kanpur, Kharagpur, Patna, BHU, Dhanbad, Delhi. Tirupati, Roorkee, Bombay, Goa, Jodhpur, and Jammu; NITs such as NIT Andhra Pradesh, Silchar, Rourkela, Puducherry, Warangal, Karnataka, Jamshedpur, Meghalaya, Surat, Tiruchirapalli, Hamirpur; IISER Bhopal, Mohali, Berhampur, and Thiruvananthapuram, IISc as well as other prominent colleges of engineering, sciences and humanities and social sciences. A notable feature of SRIP, in keeping with the Institute ethos, is students participating in research projects from across different disciplines. While at IIT Gandhinagar, the SRIP participants are treated no differently than the regular students at the Institute and are engaged in all academic and extracurricular activities of their interest. The program is expected to grow many folds in the coming years due to an increase in faculty strength, publication of work originating from previous rounds of SRIP and wider knowledge of the program and the Institute’s strengths. In this regard, the program is expected to be a crucial element in the Institute’s efforts towards attracting strong researchers and scholars to its postgraduate program of study.

Acknowledgements

The organizers of the Summer Research Internship Program (SRIP) 2024 thank IIT Gandhinagar for providing all necessary financial, personnel, and infrastructure support. The regular guidance of the Director, Professor Rajat Moona is gratefully acknowledged. The support from the academic office under the leadership of Professor Nitin and Professor Sameer Patel is put on record. The organizers are thankful to the speakers of the SRIP Lecture Series: Professor Shanmuganathan Raman, Professor Bhaskar Dutta, Professor Anirban Dasgupta, Professor Uttama Lahiri, and Professor Harini Subramanian. We also organized specialized lectures such as “Effective use of library resources & services for summer research” by Dr. Kumbar and his team and “Effective poster making session” by Prof. Sameer Sahasrabudhe**.** Special thanks are due to Mr Dilip Kashyap for his help in dealing with the data and communications. The organizers thank all participating faculty members and interns for the successful completion of the program. The student body of IIT Gandhinagar organized sports and cultural events, which added colour to the experience of the interns. Their efforts are deeply appreciated. The organizers are thankful for the help and support of all those who directly or indirectly contributed towards SRIP 2024.

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1 SRIP 2024: Statistics

A total of 75,906 internship applications were received for 134 projects offered by 67 IIT Gandhinagar faculty members, making an average of 560+ applications for a project. A total of 236 students were selected for the program (success rate of 0.3 %). Out of 204 students who joined, 63 undergraduate students were from IIT Gandhinagar, 16 undergraduates from other IITs, 10 from IISERs, 24 students from NITs, and the remaining students from other prestigious colleges across India.

2 SRIP 2024: Activities

2.1. Welcome Session

A welcome session was conducted in the Jasubhai Memorial Auditorium at IIT Gandhinagar on May 24, 2024. Our Director, Professor Rajat Moona, addressed the students and stressed independent research by undergraduates. Professor Moona urged the students to keep up with the research trends in India and contribute thoughtfully. Some real-life examples were shared with the interns with an emphasis on the SRIP opportunity, which helped the students in their future endeavours.

2.2 SRIP Lecture Series

Seven lecture sessions were conducted as part of the SRIP Lecture Series.

Prof Sameer Sahasrabudhe shared some insights into effective poster making that helped students for the SRIP poster session towards the end. Prof Uttama Lahiri, Professor of Electrical Engineering, recently delivered an insightful lecture on ‘AI-Enabled Technology in Balance Rehabilitation and Gait Quantification’ as part of the SRIP lecture series at IITGN.

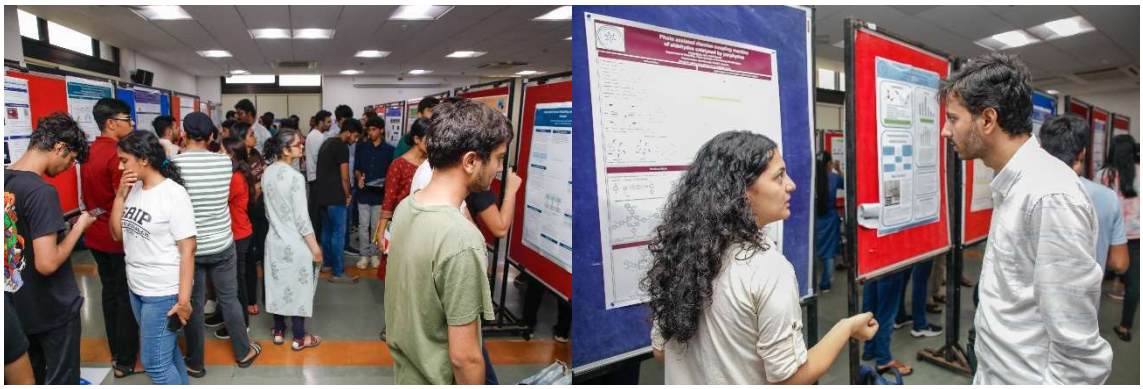
SRIP students had the opportunity to attend another engaging lecture titled ‘From Olympics to Stealth Tech: Some fascinating applications of Composites’ delivered by Prof Harini Subramanian, Assistant Professor, Mechanical Engineering.

Prof Shanmuganathan Raman delivered an enlightening talk titled ‘Understanding the World through Projective Geometry’. Dr TS Kumbar delivered a talk as part of the SRIP lecture series on ‘Effective use of Library Resources & Services for Summer Research’ recently and guided the interns on ways to maximise the library's offerings to enhance their summer research.

Prof Bhaskar Dutta excited the SRIP interns with his talk on ‘Banana: The Superfood, The Republic, and The Supermop’. Prof Anirban Dasgupta from Computer Science and Engineering lectured on the history of artificial intelligence, which was thoroughly enjoyed by the SRIP interns.

2.3 SRIP Poster Session

A poster session was organized around the end of the SRIP on July 9, 2024. The students presented posters of their work done during the summer. More than 90 posters were presented by the summer interns of SRIP 2024. The posters were evaluated by a panel of judges comprising Professors Naveen Sisodia, Soumyadip Sett, Krista, Sandip Lashkare, Biswajit Saha, Prasanna, Sameer Patel, Sushobhan Sen, Bhaskar Dutta, Harini Subramanian, Rusa Mandal, Prafull Pandey, Naveen Sisodia, and Sameer Saharasrabudhe. The panel of judges also consisted of senior PhD students and postdoctoral researchers (NVS Praneeth, Sahar, Gayatri Joshi, Abhijit Biswas, Satadru, Raghu Solanki, Yashwant Kumar, Surbhi Kewle).



3 SRE Award

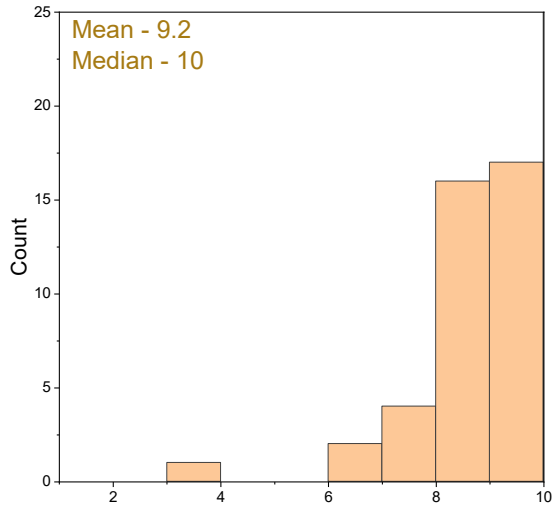
The Bhalodia-Khetan Summer Research Excellence Award aims to recognize outstanding undergraduate research internships in Engineering, Natural Sciences and Humanities and Social Sciences each year. As approved by the Board, one award in each category is to be given each year.

For SRIP 2024, the filtering process for the award was the voluntary SRIP poster presentation event held on July 09, 2024, during which 93 posters were presented. Each poster was assessed by two judges related to their subject areas. On the recommendation of the judges and the scores received, a total of 12 posters (6 in engineering and 6 in science streams) were nominated in the first stage. Subsequently, final SRIP project reports and faculty supervisor recommendations were sought for these 6 candidates. Based on the review of the letter and the projects, the committee recommended the following individuals for the award.

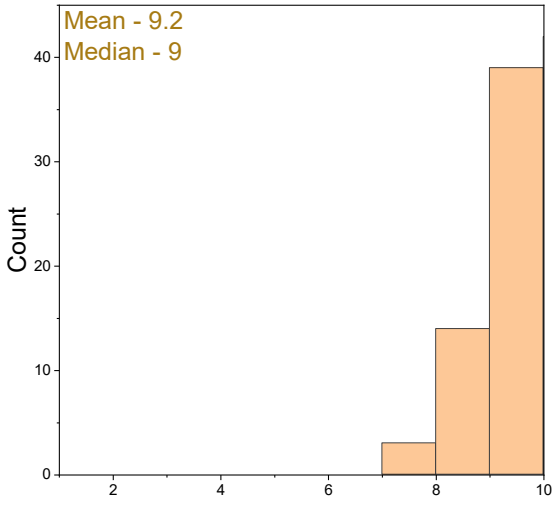
1. *Engineering:* **Devodita Chakravarty,** BTech and Mtech (Dual Degree), Mechanical Engineering, IIT Kharagpur (advised by Prof. Nipun Batra)
2. *Natural Sciences*: **Gaurav Rawat,** MSc, Chemistry, IIT Gandhinagar (advised by Prof. Sriram Kanvah)

The winners received the award of INR 50,000 on August 15, 2024 given by the director Professor Rajat Moona.

4 Student Feedback



Was your research exciting?
Rate on a scale of 0 to 10 (10 = very much so, 0 = not at all)



How was your overall experience?
Rate on a scale of 0 to 10 (10 = excellent, 0 = very poor)

5 SRIP Abstracts

Name	Title	Faculty	Department	Abstract
Aaditya Roy	Mineralization and Degradation Pathways for Acetaminophen from Pharmaceutical Wastewater	Raghavan Ranganathan	Materials Engineering	This study aims to efficiently degrade acetaminophen into its elemental constituents using Reactive Molecular Dynamics (RMD) simulations with C/H/O/N ReaxFF parameters, varying concentrations of ozone (O_3) and hydrogen peroxide (H_2O_2) were tested: 5, 10, and 15 molecules each. The goal was to optimize mineralization conditions by analyzing reaction dynamics and hydroxyl radical (OH·) formation, crucial for oxidative degradation pathways. Insights into paracetamol's degradation mechanisms and strategies for improving wastewater treatment plant efficiency were highlighted, aiming to reduce environmental and health risks associated with pharmaceutical waste.
Aarav Shah	Prototyping an Autonomous Guided Vehicle for Lab Environment		Maker Bhavan	Autonomous guided vehicles (AGV) are vehicles capable of navigating by themselves in an unknown environment. They find great uses ranging from airports, seaports, factories, and delivery vehicles. Also, passenger cars are moving slowly towards autonomous nature. This project is aimed at developing an AGV capable of carrying up to 10kgs of load and able to transport goods from one point to another autonomously.
Abeer Karandikar	Influence of non-thermal active fluctuations over colloidal dynamics under crowded conditions	Krishna Kanti Dey	Physics	In this project we measure the flow rates and the fluctuations that are observed in the flow rate due to the use of crowding agents. By looking at the fluctuations in the derivative of

				the mass we attempt to gain insight in the observed phenomenon of non-uniform flow. Studying the derivative allows us to establish a threshold on the driving force for both the 20% glycerol solution and the 10% ficoll 400 solution. We then move on to define the Recovery time as a potential way of assigning a timescale to the fluctuations as it is a parameter seen to not vary across applied flow rates or the solutions used.
Abhijit Venkat Pallapothu	JetCAP: Jet engine Cycle Analysis and Performance tool	Dilip Srinivas Sundaram	Mechanical Engineering	Recognizing the importance of accurate and accessible aerospace engineering tools, we developed a software program to calculate aircraft engine performance under various flight conditions. Inspired by tools like PARA, PERF by Jack D. Mattingly, and Gasturb, we aimed to create an alternative addressing their limitations. Our software supports turbojet, turbofan, and ramjet engine cycles, with customization options such as dual-spool configuration, afterburner, and real or ideal cycles.
Abhishek Kumar	Investigation of the use of bio-based additives in concrete	K. Siva Teja Chopperla	Civil Engineering	The study involves investigating the usage of three types of biochar, sugarcane bagasse, rice husk biochar and Pellets biochar in concrete and studying their fresh and hardened properties. The optimum dosage of biochar in the mortar was determined using flow test and compressive strength test. It was found that 2% biochar is the optimum dosage.
Abhishek Pratap Singh	Synthesis of Alkynes-Based Fluorescent	Sriram Kanvah Gundimeda	Chemistry	Project 1: Cellular organelles play a

	Probes and Ortho Hydroxyl Azobenzene Heterocyclic Dye.			pivotal role in maintaining homeostasis within dynamic cells. Visualizing these organelles enables the assessment of cellular health. Fluorophores, equipped with targeting moieties, have been instrumental in specific imaging of various organelles, including mitochondria, lysosomes, endoplasmic reticulum, nucleus, nucleolus, lipid droplets, and the plasma membrane. Organic fluorophores, due to their tunability, sensitivity, photostability, and low cytotoxicity, are preferred over other tagging agents. In this research project, we aimed to work on designing and synthesizing the D-π -A-based fluorescent probes for cellular imaging and monitoring the anatomical changes inside the cells. I tried to synthesize NIR-based fluorescence probes, which have an emission range between around 600-700 nm and large Stock's shift for cellular imaging to avoid autofluorescence imaging. We aim to understand how these modifications impact the fluorescent behavior of the dyes, leading to improved analytical techniques. Project 2: Additionally, Azo dyes and metal-complex dyes have played significant roles in the dye industry. Azo compounds find applications in coloring fibers, photo electronics, printing systems, optical storage, textiles, and biological reactions. Metal-complex dyes, known for their thermal and optical properties, are used in optical recording media, toners, inkjet printing, and oil-soluble lightfast dyes. Pyridone-based dyes, a family

				of heterocyclic colorants, have gained prominence since the 1970s. Furthermore, the Fenton-type reaction proves valuable in wastewater treatment due to its effectiveness against recalcitrant pollutants. As Copper (Cu) plays a crucial role in organizing coordination complexes involving pyridone and quinolinone-based heterocyclic dye-metal complexes. These complexes are relevant for their interactions with hydrogen peroxide (H2O2). So, the goal is to synthesize ortho-hydroxy azobenzene dyes. Instead of addressing water pollution directly, the approach focuses on preparing these dyes. So, the proposed method involves three steps: (a) Cu(II) ion catalytic oxidation in the presence of hydrogen peroxide. (b) Formation of Cu(II) complexes with ortho-hydroxyl azobenzene dyes. (c) Demetallization using specific reagents to isolate the targeting dyes.
Adithya Ananth	Developing a Large Language Model to encode Tamil	Mayank Singh	Computer Science Engineering	The rise of Large Language Models (LLMs) has revolutionised Natural Language Processing (NLP) tasks, albeit primarily in English. With over 20 Indian languages spoken by millions, such as Tamil, which has 85 million speakers, these models need a multilingual upgrade. The success of LLMs in NLP underscores the need for broader language capabilities. Current Tamil models struggle with sentence structure, character generation, and limited vocabulary. This project proposes a Tamil LLM that overcomes these limitations, allowing it to generate text and

				respond to user queries in Tamil script. We aim to build a robust Tamil model that enhances NLP applications in this widespread Indic language. The trained model and its training data will be valuable resources for future advancements in Tamil LLMs. This paves the way for utilising Tamil in tasks like sentiment analysis and text generation, empowering native speakers to leverage these models for various practical applications.
Aditi Das Talukdar	"Design and synthesis of low-valent main group compounds for activation of small molecules (e.g. N_2, H_2, CO, CO_2, ethylene etc.)"	Priyabrata Ghana	Chemistry	This Final report details the progress of my project focused on the synthesis of bis-(β diketiminato) ligand coordinated bimetallic complexes for dinitrogen activation. Over the last eight weeks, the synthesis pathway has advanced through three critical steps: converting diacid to diester, transforming diester to nitro ester, and then followed by a Grignard reaction. Each step was successfully completed, and the resulting compounds were characterized using NMR spectrometry, providing a solid foundation for further studies on the reactivity of these complexes with molecular nitrogen. The activation of dinitrogen (N_2) under mild conditions is a significant challenge due to the strength of the triple bond in N_2 molecules. Achieving this through the synthesis of bimetallic complexes coordinated by bis-(β diketiminate) ligands presents a promising approach. These complexes are designed to facilitate the binding and activation of dinitrogen, potentially leading to efficient nitrogen fixation processes. This report outlines the

				progress made in synthesizing these complexes, focusing on the steps involved in their preparation and characterization.
Aditya Adhyapak	Fluorescence sensing application from green synthesized carbon nanoparticles	Jhuma Saha	Electrical Engineering	This current research explores the green synthesis of carbon nanoparticles (CNPs) using various plant leaves, using microwave synthesis techniques. The main objective of this project was to synthesize Carbon Nanoparticles using environmentally friendly method for their application in metal ion detection. The synthesis process included leaves of Ocimum tenuiflorum (Tulsi), Psidium guajava L (Guava) and Murraya koenigii (Curry). Ease of repeatability was also kept in mind during this project hence microwave synthesis was opted. Characterization of the synthesized carbon dots was performed using techniques including Transmission Electron Microscopy (TEM) for structural analysis, UV-Vis spectroscopy for optical properties, and Photoluminescence (PL) spectroscopy for fluorescence behavior. This report details an extensive literature survey on green synthesis methods, the step-by-step synthesis process using microwave technology, characterization of the synthesized carbon dots, and an analysis of their application in metal ion sensing.
Aditya Mehta	Interaction of Amino Acids and Lanthanide Ions - A Molecular Dynamics Study	Karthik Subramaniam Pushpavanam	Chemical Engineering	The interaction of lanthanide ions, a group of chemically similar metallic elements in the periodic table, with biomolecules such as amino acids, the basic building blocks of proteins, is a topic of significant interest in the scientific community.

				Lanthanides have diverse applications in various fields, including medical diagnostics, catalysis and material science, and understanding their interactions with biomolecules such as amino acids is crucial for developing new and more effective applications. So, this project does the interaction energy calculations, free energy calculations, RMSD Averages and some other analysis calculations which will give much more broader idea for these interactions.
Aditya Prasad	JetCAP: Jet engine Cycle Analysis and Performance tool	Dilip Srinivas Sundaram	Mechanical Engineering	Recognizing the importance of accurate and accessible aerospace engineering tools, we developed a software program to calculate aircraft engine performance under various flight conditions. Inspired by tools like PARA, PERF by Jack D. Mattingly, and Gasturb, we aimed to create an alternative addressing their limitations. Our software supports turbojet, turbofan, and ramjet engine cycles, with customization options such as dual-spool configuration, afterburner, and real or ideal cycles.
Aditya Pratap Singh	Linear induction Motor and Thomson Jumping ring	Manish Jain	Creative Learning	This report explores two distinct technologies for linear motion: the Thompson Jumping Ring and the Linear Induction Motor (LIM). The Thompson Jumping Ring utilizes pulsed electromagnetic repulsion for a simple, low-cost solution. LIMs, on the other hand, leverage electromagnetic induction for high-performance linear thrust. Both technologies offer advantages and limitations, making them suitable for different applications. The report delves into the working

				principles, design considerations, potential applications, and future research directions for each technology
Aditya Raj	Development of a portable Universal Testing Machine	Manish Kumar	Civil Engineering	The report covers the grounds for what, how, and why a Universal Testing Machine is used, an alternative to the generic Universal Testing Machine (UTM) designs, and how it can be built. The primary objective of this project is to design a portable UTM that can withstand a load of 1kN. The central focus is on compressive loading on test specimens. However, the set-up can be conveniently used for tensile testing as well if an appropriate jaw is used. The report presents the details of the parts required to build the UTM. The Arduino code to control the UTM, the electronic circuit, and the electronic components are also discussed in detail. The machine should weigh approximately 30 kg. The parts are designed so that they can be upgraded in the future. A few parts are detachable, making the UTM flexible. The report is expected to facilitate the fabrication of the UTM.
Aindrila Kundu	POC/Prototyping of Pneumatic Hand Glove for Finger Joint Rehabilitation		Maker Bhavan	This project report details the design and fabrication of a soft pneumatic finger, aimed at creating rehabilitation equipment to aid patients in regaining hand function after an injury or stroke. The soft actuator, composed of multiple adjacent air chambers, was fabricated using a casting process with silicone rubber (Mold Star -15). We designed

				the 3D model of the actuator in CAD software and produced prototypes using a 3D printer. Inspired by the flexible movement of human fingers, we incorporated this design into robotic fingers. These robotic fingers were then mounted onto a glove to form a rehabilitation device that supports patients in their recovery by assisting with repetitive hand exercises, essential for restoring normal hand function. This soft pneumatic robotic glove is lightweight, comfortable, safe, easy to operate, and accessible to all users. Additionally, the glove's performance can be fine-tuned by controlling the air pressure within the fingers, allowing adjustments to force, bending angle, and response time. The results demonstrated that the glove could successfully grasp and hold objects with a small mass.
Akshith Karthik	Designing Efficient OLEDs with Machine Learning	Anirban Mondal	Chemistry	The aim of the project is to be able to identify which organic compounds can be used in the activation layer of OLEDs to be able to produce the most amount of energy. Using machine learning approaches such employing the SchNet model and Delta-Machine Learning, we will be able to identify the organic compounds that are likely to have favorable physical characteristics without the need for experimental verification, which is a costlier method. The mode of proceeding is to use high level values derived from costlier calculations and values obtained from lower level calculations and attempt to match using a correction

				factor. My role in the project mainly revolved around being able to predict the correction factor.
Anish D	Solvent- Free Recovery of bioactive compounds in organic raw materials from natural sources using Hot pressurized water extraction.	Sameer Dalvi	Chemical Engineering	Bioactive compounds are natural or synthetic substances that affect living organisms, tissues, or cells. These compounds, often found in plants, foods, and medicinal herbs, can influence various biological processes and benefit health. Here, we studied and experimented with extracting bioactive compounds in organic raw materials from natural sources using hot pressurized water. Traditional extraction methods often rely on organic solvents such as methanol, ethanol, DCM and Diethyl ether, which can harm the environment and human health. This research focuses on using the subcritical water extraction method, which involves maintaining the temperature and Pressure of water between 100-374 degrees and 1-218 atm. These conditions make water a viable solvent for extraction and, thus, a green alternative. The subcritical water extraction method effectively breaks down cell walls and solubilizes bioactive compounds, efficiently recovering valuable bioactives without toxic solvents. Five raw materials were subjected to subcritical water extraction: Rose, Marigold, Banana, Eucalyptus and Neem. Critical parameters such as temperature, Pressure, extraction time, and solid-to-liquid ratio were maintained to be constant. The bioactive extracts were then analyzed using various analytical techniques to

				determine the extract composition and behaviour. The findings indicate the presence of more than 20 bioactive compounds in each extract, which are used in everyday life for various purposes. The findings also prove that the subcritical water extraction method is viable and eco-friendly for obtaining high-quality bioactive compounds from natural sources, with significant applications in the food, pharmaceutical and nutraceutical industries
Ansh Desai	Nanoscale Warriors: Battling Antimicrobial Resistance	Dhiraj Bhatia	Biological Engineering	Antimicrobial resistance (AMR) is one of the top global concerns for public health. According to WHO estimates, AMR was responsible for 4.95 million deaths in 2019. AMR occurs when bacteria, fungi, viruses, and other pathogens cease to respond to conventional drugs and antimicrobial agents, acquired over time due to the selection pressure of overused antimicrobial agents. Consequently, these agents lose their effectiveness. Microorganisms have evolved mechanisms to prevent drug entry or deactivate them altogether. While strategies like combination therapy, bacteriophage therapy, and antimicrobial peptides have been explored to combat AMR, they are fraught with limitations. The emergence of nanotechnology offers a promising solution for AMR due to nanomaterials' ability to target various biological pathways. This capability may mitigate concurrent mutations in microorganisms that lead to resistance. Combining traditional antibiotics with nanocarriers has demonstrated enhanced

				efficacy against drug-resistant bacteria. Moreover, nanomaterials facilitate improved delivery of antimicrobial drugs and help prevent the development of resistance. This review highlights recent advancements in nanomaterials-based approaches to combating AMR, contrasting them with other strategies.
Anuja Gangaram Girap	Development of an approach for mineral tonnage estimation using physical characteristics of minerals at different grain sizes.	Vikrant Jain	Earth Science	Tonnage, the mass of minerals in a unit 'tonne', requires grade, volume, and bulk density (BD) or specific gravity (SG) for accurate measurement. Studies have shown that bulk density is preferred over specific gravity due to various ambiguities in specific gravity measurements, such as reference fluid's specific gravity, solubility, and temperature variations. Accurate tonnage calculation focuses only on mineral content, excluding waste, using grain volume and grain density. Porosity also affects tonnage, which is calculated as the pore space ratio within a sample. It should be noted that grain density is crucial for tonnage estimation, which stays consistent despite porosity, emphasising its importance over bulk density in precision. This study aims to establish a per-tonne penalty cost for illegal mineral mining by achieving the following objectives: the first is to identify the most accurate parameter between specific gravity and bulk density for tonnage estimation. Second, to find reliable conversion factors for calculating the tonnage of in-situ and

				stockpile minerals. The last is determining the effects of mineral degradation and weathering on the physical properties of minerals, like porosity, volume, and density, impacting tonnage estimates. These are essential for fair penalty assessments and, thus, effective industry regulation. For this, we collected the mineral samples, noting the coordinates using GPS, from GRMDC mines in Morbi, Surendranagar, and Kutch districts of Gujarat. Adhering to GMDC protocols, the sampling procedures involved chip channel and grab sampling methods. Then, we analysed the samples using different methods for aggregate and block samples to determine physical parameters like porosity and grain and bulk densities. A Python-based tonnage calculator was developed using the mean and standard deviation of volume, porosity, and density from sample readings. We found a relation between grain size and porosity from basalt samples of Yashpal Dodia, Kelvastone, and Ikrupa leases, which revealed a medium to strong correlation (r2 = 0.57 to 0.67). This indicated that porosity increases with grain size. The tonnage estimation formula after simplifying some equations is: Tonnage = grain density x bulk volume x (1 - (porosity/100)), where the conversion factor is (1 - (porosity/100)). In the future, work could be done to explore the impact of physical characteristics on tonnages, such as pressure effects and the relation between grain shape, porosity, and

				permeability, for a clearer understanding.
Anurag Kartikeyan	Exploring the inhibitory effects of novel small molecules on point mutants of Helicobacter pylori IMPDH	Sivapriya Kirubakaran	Biological Engineering	Helicobacter pylori (H. pylori) is a gram-negative bacteria that colonizes the stomach's mucus lining and is the major cause of several severe gastrointestinal diseases, including gastritis, peptic ulcers, and gastric cancer. H. pylori has developed resistance to current antibiotic treatments, resulting in high failure rates and necessitating new therapeutic strategies. A crucial enzyme in H. pylori is inosine-5'-monophosphate dehydrogenase (IMPDH), pivotal for de novo purine nucleotide biosynthesis, playing an essential role in converting IMP into XMP, which is further converted into GMP . The rapid multiplication of bacterial infections relies on the rate-limiting enzyme IMPDH to expand the guanine nucleotide pool. Guanine nucleotides are necessary for DNA and RNA synthesis, energy transfer, and metabolic regulation. Hence, by inhibiting IMPDH, we can stop the growth of the guanine nucleotide pool and curb the spread of the bacteria. Structural and kinetic differences between bacterial (prokaryotic) IMPDH and host (eukaryotic) IMPDH, particularly in the NAD+ binding domain and flap region, allow for selective targeting . This selective targeting makes it possible to develop potent and specific inhibitors of bacterial IMPDH, making IMPDH a promising target for treating H. pylori

				infections, especially in the context of rising antibiotic resistance. In this project, we expressed, purified, and looked into the effects of synthesized small molecules of the SPK SH series on the point mutant Y 439A (YΔA) and the wild-type Helicobacter pylori IMPDH.
Anushka Singh Jaiswal	Autonomous Guided Vehicle		Maker Bhavan	This report details the progress of the project "Autonomous Guided Vehicle for Lab Environment," undertaken by Aarav Shah and me at Maker Bhavan IITGN. I joined Maker Bhavan as a summer research student in May and worked on this AGV project with the assistance of Aarav Shah, a second-year student at IITGN. The project's primary objective is to develop an AGV capable of autonomously carrying up to 10 kg within a laboratory setting. Building upon a pre-existing model, significant modifications were made to the steering mechanics, transitioning to a rack and pinion system utilizing 3D printing. Initially, the existing prototype was reinstated and made operational, ensuring smooth and accurate control. After thoroughly working on the previous model, the focus shifted to developing the final prototype. All necessary hardware components were procured and integrated, and the design phase was completed, covering mechanical, electrical, and software aspects.
Aprajita Sharma	Designing a User-Friendly Probabilistic Seismic Hazard Web Portal for Public Safety	Utsav Mannu	Earth Science	This project aims to create a user-friendly web portal for the general public in India that provides easy access to earthquake risk data. The primary goal is to develop a simple interface and

				interactive tools to help Indian communities better understand and prepare for seismic hazards. By making seismic data accessible, the portal will enable citizens to make informed decisions regarding their safety.
Arun J	Hydrovoltaic energy generation using vermiculite sheets	Gopinadhan Kalon	Physics	Extracting power from sustainable sources remains a crucial milestone for humanity, and hydrovoltaic energy generation (HEG) appears to be a promising solution. In this study, the use of vermiculite as an agent to produce HEG cells is investigated. Utilizing vacuum filtration, we synthesized free-standing sheets of ion-intercalated vermiculite to analyze their effectiveness. HEG cells were designed both in-plane (along the capillary) and out-of-plane (across the capillary). The in-plane HEG cell produced a power density ranging from 0.6 - 0.9 mW/m^2 in deionized (DI) water. However, its response in alternative fluids like acetone, ethanol, and isopropanol (IPA) showed a significant decrease in power density. Na^+ and K^+ intercalated vermiculite sheets demonstrated a decreased rate of rise to peak voltage with increased thickness, while Ca^{2+} intercalated vermiculite showed the opposite trend. The out-of-plane HEG cells produced a power density in the range of 5.66 – 33.6 mW/m^2 across different designs; but showed poor stability in short circuit current behaviour. Porous vermiculite sheets, made to counter the saturation of membranes, confirmed by repeated drying tests were found to produce power density in the range of 0.1 –

				1.6 $mW/m2$ Meanwhile out of plane HEG cells exposed to mixtures of ethanol + water and acetone + water showed power densities in the range of 10.5 - 16.8 $mW/m2$ and 31.8 - 63.75 mW/m^2 respectively. These findings confirm the potential and eligibility of using vermiculite sheets as an agent for hydrovoltaic energy generation.
Arun Kumar Jha	Investigation of the use of bio-based additives in concrete	K. Siva Teja Chopperla	Civil Engineering	In this study, we explored the feasibility of replacing a portion of cement with biochar to reduce CO_2 emissions in concrete production. Based on 8-day strength values, we determined that up to 2% of cement by mass can be replaced with biochar, resulting in CO_2 emission reductions of 14.6 kg and 20.76 kg per cubic meter of concrete for rice husk and sugarcane bagasse biochar, respectively. Further analysis of 28-day strength values revealed that up to 5% of cement by mass can be replaced with biochar, leading to CO_2 emission reductions of 36.5 kg and 51.9 kg per cubic meter for rice husk and sugarcane bagasse biochar, respectively. Overall, the maximum CO_2 reduction achieved was 52 kg per cubic meter of concrete, equivalent to the emissions from an average diesel car travelling 390 kilometres. Given that concrete is the second most consumed substance on Earth after water, these findings suggest that biochar substitution at industrial scales could significantly mitigate CO_2 emissions in the construction sector.
Aswin M	Asymmetric Organocatalysis	Chandrakumar Appayee	Chemistry	The discovery of the Wittig reaction provides a new method for the synthesis of olefins. The advantage of this

				method is that the carbonyl group can be replaced by a carbon-carbon double bond without the formation of olefins. Another advantage is that it can be carried out in mild conditions as well. It undergoes SN2 reactions. A Wittig reaction is a chemical reaction where the aldehyde or ketone is reacted with triphenylphosphonium ylide to give an alkene. Here, the triphenylphosphonium ylide is known as the Wittig Reagent. There are many kinds of variations and modifications of the Wittig reaction that have been developed to expand its scope and its usefulness in organic synthesis. There are many kinds of Wittig reactions. My work is with Horner wardsworth emmons reaction, In this reaction, a phosphonate ester reacts with an aldehyde or ketone under basic conditions to give an alkene. This reaction is milder when compared to the original Wittig reactions, and it also provides higher yields of E-configured alkenes. I Have done this reaction using various starting materials like Nitro, methoxy, bromo, fluoro substrates. I have done column chromatography, TLC and rota for each and every reaction and got a good yield in percentage. I have sucessfully performed the Wittig reaction to convert the carbonyl groups to alkene using electronically different substrates.
Atharv Dattatraya Nangare	Determination of Parameters for Acoustic Vehicle Alerting System (AVAS) using	Meera M Sunny	Cognitive Science	The study aims to enhance the Acoustic Vehicle Alerting System (AVAS) by incorporating principles of perception and attention from cognitive neuroscience to

	Psychophysical Methods			extend its effective range and minimize drive-by noise. AVAS alerts both drivers and pedestrians about potential hazards, requiring immediate attention and action. Given the continuous cognitive processes both parties engage in while navigating streets, AVAS alerts must capture attention efficiently, and at an optimum point in time. A go/no go task, transformed into a Continuous Performance Task (CPT), was designed to measure response inhibition under various cognitive loads. The CPT involved continuous presentation of stimuli, requiring participants to respond to all but one specific stimulus, gauging attention and inhibition effectively. The experiment was designed using Psychopy v2024.1.5. The task required participants to continuously press a key for go trials and release it for no go trials, integrating both visual and auditory stimuli. The findings will contribute to optimizing AVAS alerts presentation timings.
Atharva Bodhale	Nanoengineered Surfaces for Thermal Management Applications	Soumyadip Sett	Mechanical Engineering	The project was a continuation of our project course. We faced few challenges on the way but with the guidance of our TA mentors and Prof.Soumyadip, we were able to complete a significant portion of what we had intended. This research investigates the heat transfer properties of TiB_2-coated nano-sheets on copper substrates. The study evaluates their potential as efficient heat spreaders and explores their antifouling characteristics. A series of experiments were conducted, including heat spreading tests, single drop

				evaporation assessments, drop area analysis, multiple drop tests, and antifouling tests on bare copper. The performance of TiB_2-coated nano-sheets on copper was compared with that of bare copper
Atharva Sachin Keny	Designing a New Computational Workflow for Creating Efficient Molecules for Organic Solar Cells	Anirban Mondal	Chemistry	This report presents a comprehensive workflow for creating new Acceptor-Donor-Acceptor (ADA) molecules aimed at enhancing the efficiency of organic solar cells (OSCs). The method leverages the structural properties of existing ADA molecules to generate new ones with the highest-performing subunits. Starting with an initial dataset of 300 molecules, we fragmented these molecules using RDKit. These fragments were then clustered using k-means clustering. We recombined the clusters and predicted their properties using Chemprop, which employs Graph Neural Networks (GNN) and Message Passing Neural Networks (MPNN). Finally, the properties of selected molecules were validated through Density Functional Theory (DFT) calculations to determine their suitability as ADA molecules for OSCs.
Atharva Tiwari	AI-enabled Antenna Design	Ravi Hegde	Electrical Engineering	This project focuses on the design and optimization of a pixelated antenna using machine learning techniques. The initial design utilized a 6x6 pixel grid with each pixel containing 36 rectangular patches, which was iteratively refined to improve performance and reduce metal content. The final design comprised 18 rectangular patches per pixel on one half of the board, mirrored on the other half, achieving a 73% resonance rate across 2800

				samples. The dataset generated included features and S11 values for each design, which were used to train various machine learning models including feedforward neural networks, 1D CNNs, and a specialized 3D CNN. Despite the complex data and limited dataset size, the 3D CNN achieved a mean squared error (MSE) of 5.26. Active learning techniques such as Bayesian optimization and Query By Committee were applied to further improve model performance with fewer labeled instances. This approach demonstrates significant advancements in antenna design, potentially transforming how such designs are approached in the industry.
Avadhoot Nadgouda	Back assist exosuit	Vineet Vashista	Mechanical Engineering	This report outlines the work conducted during an eight-week internship on the Back Assist Exosuit project. The primary focus was to explore the relationship between trunk flexion angles and the assistive torque provided by the extended moment arm exosuit. The trunk flexion angle and the duration for which this angle is maintained are critical factors. By identifying the forces acting on a human while maintaining an angled back in the sagittal plane, we analyzed how these forces induce significant strain on the lumbosacral region, thereby increasing the risk of Musculoskeletal Disorders (MSDs). A comprehensive mathematical model was developed using static equations in the sagittal plane to optimize the moment arm configurations in the exosuit. This model aimed to determine the configurations that would provide the

				necessary assistive torque while ensuring user comfort and minimizing strain. From this model, six configurations were selected for experimental testing based on their predicted performance in reducing lumbosacral strain. The experimental setup involved simulating postures and movements typical of tasks performed by nurses and gardeners, such as patient handling and cutting overgrown grass. In the baseline experiment, the subject stooped at mean and extreme angles while carrying a 10kg load, maintaining each posture for one minute. A dynamic task was also included, where the subject transitioned stooping from an upright posture to an extreme posture over two cycles, holding each pose for 20 seconds. Electromyography (EMG) values of the Left Erector Spinae (LT_ES), Right Erector Spinae (RT_ES), Left and Right Multifidus (LT_MF, RT_MF), and Left and Right Rectus Abdominis (LT_RA, RT_RA) were recorded.
Ayushi Mohanty	Learning the basic techniques of mammalian cell culture	Sivapriya Kirubakaran	Biological Engineering	Animal Cell Culture is the in vitro maintenance and proliferation of animal cells that will continue growing outside living organisms when supplied with proper nutrients and growth conditions. This project focussed on studying the effect of inhibitor drug molecules on particular Glioblastoma cell lines (LN229, LN18, and U87 MG) through various assays like CTG and Clonogenic assay. This was then followed by Western Blot analysis to check the protein expression level in the cell lines.

Barham Dev khati	Synthesis of fluorescent dye intermediates	Sriram Kanvah Gundimeda	Chemistry	We focused on synthesizing fluorescent dyes for drug targeting in cancer cells. The dyes were synthesized through various chemical reactions and purified using column chromatography. The desired product was confirmed by Nuclear Magnetic Resonance (NMR) spectroscopy and tested on cancer cells using a confocal microscope.
Bhaswar Dutta	Dynamic analysis of drop landing on lunar surface	K R Jayaprakash	Mechanical Engineering	Exploring the Moon is pivotal for advancing human knowledge and extending our presence beyond Earth. A critical aspect of these missions is the safe and reliable landing of spacecraft on extraterrestrial surfaces, where unique environmental and terrain challenges are encountered. This research project focuses on the dynamic analysis of drop landing for lunar landers, using MSC ADAMS to simulate and assess various impact conditions. By developing a 2D model of a lunar lander and conducting a series of simulations, we aim to understand the echanical responses and stability of the lander during touchdown. The findings from this study will contribute to optimising landing mechanisms and enhancing the safety and success rate of future missions to the Moon.
Bhoumik Patidar	Efficient Generative Adversarial Networks via Knowledge Distillation And GAN based Satellite Image To Map Translation	Shanmuganathan Raman	Computer Science	This summer research internship focused on exploring and implementing advanced generative deep learning techniques for computer vision applications. The primary projects included GAN knowledge distillation for MNIST digit generation and satellite-to-map image translation using GANs. In the first project, we successfully

				trained a smaller, more efficient GAN model through knowledge distillation, maintaining generation quality while reducing model size by approximately 60%. The second project implemented a pix2pix-inspired conditional GAN for translating satellite imagery into map-style images, demonstrating the potential of deep learning in automated cartography. Additional explorations included satellite image compression using GANs and investigations into GAN latent space properties. These projects collectively contribute to the field of generative AI by addressing efficiency, practical applications, and theoretical understanding of GANs in computer vision tasks.
Bipasha Nayak	Understanding the crystallisation and supramolecular packing of in-house molecules with anti-cancer properties through small molecule crystallography.	Vijay Thiruvenkatam	Biological Engineering	Crystals are solids with atoms, ions, or molecules arranged in a repeating three-dimensional pattern. They are categorised by their physical properties, atomic bonds, and crystalline structures. Chemical crystallography is crucial for understanding these arrangements, providing insights into long-range interactions, bond distances, angles, and chirality. Deriving the atomic arrangements would provide information regarding the supramolecular bondings between the molecules as well as the crystal stability. Since molecules with anti-cancer properties are used for this project, deciphering their structures becomes necessary for developing pharmaceutical agents with improved therapeutic outcomes.
Birudugadda Srivibhav	Large Language Model for Telugu	Mayank Singh	CSE	The project aims to develop a robust Telugu Language

				Model (TLM) to enhance natural language processing (NLP) capabilities for the Telugu language. Addressing the limitations of existing models, which often lack depth and diversity in training datasets, we conducted a comprehensive analysis of several current Telugu language models and curated a diverse set of textual data from historical archives, news sites, and public datasets. Our methodology involved systematic stages of data collection, cleaning, deduplication using advanced algorithms like min-hash, and preparation for model training through tokenization. The project's progress has laid a strong foundation for pre-training the TLM, followed by fine-tuning for specific applications such as text generation. Ultimately, this endeavor seeks to significantly contribute to NLP tasks in Telugu, supporting both academic research and practical applications in language technologies.
Chaitanya Raj	Geospatial Mapping Satellite-Derived Shoreline Trends and Describing Long-Term Variability Along the Gujarat Coast of India	Vikrant Jain	Earth Science	Satellite remote sensing is now widely used in coastal sciences to monitor shoreline changes. Gujarat's vast, diverse, and dynamic shoreline requires long-term study and monitoring to understand past sediment transport and predict future changes, which is crucial for effective coastal management. The current study utilizes a large-scale satellite-derived dataset and advanced geospatial techniques to analyze shoreline trends over a 32-year period from 1990 to 2022. Images were derived from Landsat 5, 7, 8, and 9, with methodologies including the

				Modified Normalized Difference Water Index (MNDWI) and subpixel mapping employed for precise shoreline extraction. Tidal correction models and composite image generation were integrated to reduce short-term variability and improve mapping accuracy. Our analysis identified spatial patterns and different hotspots of coastline change along this wave-exposed coast of Gujarat. Transects drawn at 100-meter intervals along 74 km of coastline provided significant insights into erosion and accretion patterns, validated against survey data to ensure reliability. The present study underlines the complex interactions between meteorological and oceanographic forces with geological and geomorphological controls, and human activities influencing sediment transport and shoreline changes. The study also highlights the importance of water-level corrections to the shoreline positions obtained through direct statistical analyses in satellite imagery, which are essential for reliably studying both global and local beach changes. The findings emphasize the need for continuous monitoring and subsequent adaptive management of strategies to sustain and protect coastal ecosystems in Gujarat. This study provides a robust framework for future coastal research and management initiatives.
Chaitanya Sunil Bhardwaj	Idiomatic (Literal and Figurative) Processing in Hindi Speakers Using EEG ERP Analysis	Jooyoung Kim	HSS	For a long time, idiomatic processing has been a big debate, considering the fact that idioms are conventional. Recent works of classifying

				them into compositional and non-compositional have raised the question of whether this processing is literal word-word processing or whether the idioms are processed as a unit in the mental lexicon without paying attention to the constituent words. According to various literature, the literal processing of idioms seems to be heavily supported and has proved to be useful in explaining various characters of the idiom that supported the view that idioms are mentally represented as a unit. Brain imaging methods have also been employed to understand idiomatic processing, and literature has shown the involvement of decision-making systems which mostly would happen if word-to-word processing occurs.
Chardiya Vanshribahen Rajeshbhai	Existence, uniqueness and qualitative theorems in ODEs	Jagmohan Tyagi	Mathematics	In this research paper of "Existence, uniqueness and qualitative theorems in ODEs", I have explored theorems concerning the existence and uniqueness of solutions to ordinary differential equations (ODEs), such as Picard's theorem and Peano's theorem. I have addressed the importance of determining the solution or the range of existence and uniqueness for differential equations and outlined straightforward methods for achieving this. Additionally, I discussed how these theorems apply to systems of equations, varying initial conditions, and nth-order equations, encompassing complex systems and solution continuation. The paper also covers applications of ODEs.
Chetan Rajendrabhai Choudhary	Develop SpiroMask End-to-End	Nipun Batra	Computer Science	The Spiro Mask project aims to revolutionize lung health monitoring by developing a wireless, compact, and real-

				time system for audio signal transmission and analysis. This research addresses several key challenges in traditional spirometry, including the reliance on wired connections and cumbersome hardware. By utilizing Bluetooth-enabled earbuds and replacing the Arduino board with a more compact Bluetooth module, the project significantly enhances portability and user convenience. Furthermore, the system achieves semi-real-time processing and display of audio signals, providing immediate feedback on lung health. An intuitive Android application developed using the Flet framework displays two critical values: • Maximum Peak: Indicates the strongest breath, reflecting overall lung capacity. • Peak at One Second: Provides insights into the forced expiratory volume, crucial for diagnosing conditions such as asthma and COPD. The results demonstrate: • Successful wireless transmission • Effective real-time signal processing • User-friendly app interface
Chitranjan Mishra	What is the role of topography on the effectiveness of dams on Indian rivers?	Vikrant Jain	Earth Science	This report investigates the influence of topography on the effectiveness of dams on major Indian rivers, emphasizing the critical role of Digital Elevation Models (DEMs) in site selection and design. Dams serve multiple purposes, including water supply, hydroelectric power generation, and flood control, making their optimal placement essential for maximizing benefits while

				minimizing environmental impacts. We will analyze data from six significant dams, focusing on topographic characteristics such as dam height, reservoir capacity, hydroelectric output, and elevation above sea level. By examining correlations between these parameters—specifically the ratios of electric capacity to water capacity, catchment area, and dam height—we aim to understand how topography affects dam performance. Additionally, we will predict optimal locations for new dams by assessing the ratio of absolute relief to local relief. This comprehensive analysis aims to inform engineering decisions, promoting resilient and sustainable infrastructure that balances stakeholder needs with environmental considerations.
Chrionzit Biswas	Design of Integrated STEM Education Games/Toys Kits for Grades 6-8	Manish Jain	Creative Learning	We started by identifying gaps in current STEM education for middle schoolers. While theoretical knowledge is well covered, practical application and engagement were lacking. Thus, we decided to create interactive games and toy kits to fill this gap and align with school curriculum standards.
Debojit Das	Robots that learn on their own through physical interaction with the environment	Harish P M	Mechanical Engineering	Iterative Learning Control (ILC) is a powerful method for improving the performance of repetitive tasks by learning from past iterations. However, its application is often limited to specific tasks, requiring significant reiteration when encountering new tasks. This paper proposes a novel approach for generalizing ILC across similar tasks by leveraging mathematical task and input transformations. By modifying the stored input

				based on the transformation of new trajectories in terms of previously learned trajectories, this method facilitates the adaptation of learned control policies to new tasks without the need for extensive relearning. The effectiveness of the proposed approach is demonstrated through theoretical analysis and simulation studies on dynamic systems like robotic manipulators. In addition, this research project also explored the concept of robots that learn on their own through physical interaction with the environment. By incorporating ILC with real-time feedback from physical interactions, robots can autonomously refine their control strategies. This approach allows robots to adapt to new tasks and environments efficiently, reducing the need for manual programming and extensive retraining. The integration of physical interaction feedback with ILC enhances the robots' ability to perform complex tasks, such as manipulation and navigation, in dynamic and unstructured environments. Simulation results and experimental validations highlight the potential of this combined methodology in advancing autonomous robotic learning and task execution.
Deshna Mishra	Expression and Purification of Gamma Secretase Activating Protein (GSAP) to observe Dimerization results	Vijay Thiruvenkatam	Biological Engineering	Alzheimer's disease (AD) is the principal cause of dementia in the elderly. With increasing longevity and the absence of a cure, AD has become not only a major health problem but also a heavy economic burden worldwide. Accumulation of neurotoxic amyloid-beta (Aβ) peptides is a major

				characteristic of the AD brain and is responsible for its clinical manifestation. Because formation of Aβ is under the strict control of the gamma-secretase complex, its pharmacological blockade is an attractive therapeutic approach for lowering Aβ. However, full blockade of gamma secretase has deleterious effects because this enzyme is also involved in the proteolytic processing of substrates other than Aβ precursor protein (APP), such as Notch-1 and cadherins. Recently, a study identified a gamma secretase-activating protein (GSAP) that facilitates Aβ production by interacting directly with this secretase without affecting the cleavage of Notch. Therefore,GSAP is potentially a relevant target for a viable therapeutic strategy aimed at interfering with pro-amyloidogenic effectors. Gamma secretase activating protein (GSAP) plays a crucial role in the regulation of amyloid-beta (Aβ) peptide production, which is implicated in the pathogenesis of Alzheimer's disease (AD). It interacts with γ secretase, a multisubunit protease complex responsible for the cleavage of amyloid precursor protein (APP) to generate Aβ peptides. It acts as a modulator and accentuates the truncation of the amyloid precursor protein C-99 fragment through the γ-secretase complex. My research aims to investigate the expression and purification of GSAP to facilitate its dimerized structural and functional studies.
Devodita Chakravarty	Super Resolution approach for the	Nipun Batra	Computer Science	This report presents a comprehensive study on the application of super-resolution

	detection of brick-kilns using Sentinel-2			(SR) techniques to enhance the detection of brick kilns using Sentinel-2 satellite imagery. Traditional methods for monitoring brick kilns are resource-intensive and costly, necessitating the exploration of cost-effective alternatives. We investigate three SR techniques—Bicubic Interpolation, SRCNN, and ESRGAN—to improve the resolution of Sentinel-2 images, followed by object detection using the YOLO algorithm. The SR-enhanced images demonstrate improvements by around 85% in detection accuracy. Our results indicate that integrating SR techniques with freely available satellite data provides an effective and scalable solution for environmental monitoring and pollution control, offering continuous and extensive surveillance capabilities.
Dhawal Kabra	Optimizing Human-Arm Biomechanics with Exoskeletons: A Reinforcement Learning Approach in MyoSuite	Vineet Vashista	Mechanical Engineering	This research project focuses on optimizing the biomechanics of the human arm through the integration of exoskeletons, utilizing a novel reinforcement learning approach within the MuJoCo simulation framework. Our primary objective was to develop a detailed simulation of human elbow dynamics to assess the impact of exoskeletal assistance on muscle activation patterns and joint mechanics. By employing advanced simulation tools and human physiology libraries, such as MuJoCo and MyoSuite, we created an iterative testing environment that simulates real-world mechanical and physiological conditions. Significant advancements were made in modeling elbow biomechanics, enabling

				comprehensive data collection within the simulation. This data was then used to train the exosuit using modern control methods, such as machine learning and reinforcement learning. Key findings suggest that exoskeleton use significantly reduces muscle effort, particularly in tasks involving movements against gravity, which may have profound implications for the design of assistive technologies in both rehabilitative and industrial applications. Future work will extend these methodologies to more complex anatomical structures and incorporate advanced control techniques to further optimize exoskeleton functionality. This research contributes to the broader field of biomechanics by providing scalable methods for the design and testing of wearable robotic aids.
Dipesh Kumar Kamati	Structural dynamics of composite foot for Lunar/Martian lander	K R Jayaprakash	Mechanical Engineering	This research focuses on developing a composite foot for lunar and Martian landers, addressing the need for lightweight, high-performance materials in planetary exploration. Key objectives included material selection, design optimization, finite element analysis (FEA), and prototype development. Carbon fiber composites and Kevlar were identified as optimal materials due to their thermal stability and mechanical strength. The final design, featuring a multi-layered structure with reinforced stress points, ensures maximum load-bearing capacity and structural integrity. FEA simulations and experimental testing validated the design, confirming excellent impact resistance and thermal

				performance. Extended testing under simulated conditions confirmed the composite foot's long-term durability, leading to refinements and successful integration with lander systems. This research highlights the potential of composite materials to enhance the safety and efficiency of landing systems, laying a foundation for future planetary exploration missions.
Divyajeet Chaudhary	Phase-field modelling of structural slabs	Sushobhan Sen	Civil Engineering	The analysis of a structural slab using PreproMax, with a specific emphasis on understanding the convergence behavior of reaction forces as the mesh is refined. The study involves creating a detailed 3D model of the slab using Gmsh, followed by generating structured meshes with quadrangle elements. The loads and boundary conditions are meticulously defined to reflect realistic scenarios, and the elastic and inelastic analysis is conducted using PreproMax. To investigate how reaction forces change with increasing element numbers, aiming to identify the point of convergence. By plotting the relationship between reaction forces and element numbers, the study provides a visual representation of the convergence pattern. This analysis highlights the importance of mesh quality and refinement in achieving accurate and stable numerical results in finite element analysis (FEA).
Divyam Gupta	PollutionMapper: Tackling air pollution problem from the domain perspective	Nipun Batra	Computer Science	PollutionMapper aims to explore various air pollution sources using sophisticated ML techniques like the Physics Informed Neural Network. We

				seek to identify and utilise key predictors of air quality in a machine-learning model, enhancing the accuracy and reliability of pollution mapping. The project does not make predictions solely based on machine learning methods; instead, it considers domain knowledge and incorporates air pollution dynamics to make predictions more accurate. The project seeks to give the pm 2.5 concentration values at places where direct monitoring is not possible.
Gadiraju Manvitha	MEG data to video prediction	Krishna Prasad Miyapuram	Social Sciences	This study explores multimodal affect prediction using the DECAF dataset, which contains MEG, video features, and other physiological signals recorded while participants viewed affective multimedia content. Our research focused on three main prediction tasks: 1) video prediction from valence and arousal ratings and video features, 2) valence and arousal prediction from video features, and 3) valence and arousal prediction from MEG features. Results indicate that ensemble methods, particularly Random Forest, yield superior accuracy when using video features for prediction. Conversely, Support Vector Machines (SVM) demonstrate better performance when utilizing MEG features, aligning with findings from previous research.
Gaurav Meena	Food Analysis & Development: Protein and Micronutrient Rich Food Products	Bhaskar Datta	Biological Engineering	The development of an apple-flavored cookie incorporates innovative and health-conscious ingredients such as defatted coconut powder, maize, apple pomace powder, apple sauce, baking powder, milk, and melted butter. The recipe and methodology

				emphasize natural binding agents, minimal artificial additives, and enhanced nutritional profiles, making the cookies a healthier alternative in the snack market. Future prospects include tapping into market trends favoring health-conscious, clean-label products, and leveraging seasonal and regional appeal. Nutritional innovations focus on functional ingredients that promote digestion and provide essential vitamins. Sustainability is addressed through the use of apple by-products, contributing to waste reduction and ethical sourcing. This project fosters innovation and creativity in recipe development, offers technical and analytical skill-building opportunities, and provides insights into market research and business planning. Comprehensive analysis encompasses formulation development, sensory evaluation, nutritional profiling, shelf-life testing, and marketing strategy. By blending culinary innovation with nutritional science and business acumen, the project aims to create a market-ready apple-flavored cookie that meets consumer demands for healthier, flavorful snacks.
Gaurav Rawat	Unveiling the role of DMAE linker in the tamoxifen using organic fluorescent probes	Sriram Kanvah Gundimeda	Chemistry	Tamoxifen is a hormone therapy drug used to treat hormone receptor-positive breast cancer. It can greatly reduce the risk of cancer recurrence (return) and invasive cancer. Some people take tamoxifen to lower the risk of developing breast cancer. The established structure-activity relationship (SAR) can guide future design efforts towards probes with improved cellular uptake, targeted

				localisation, and potentially enhanced photophysical properties for breast cancer diagnosis and therapy. By using the organic fluorescent probes as investigative tools, we can gain valuable insights into the linker's role and ultimately contribute to developing more effective strategies for combating breast cancer.
Gauri Gunjyal	Language choices for Inner Speech in Multilinguals	Jooyoung Kim	HSS	Inner speech is a widely utilized phenomenon across all ages, serving various cognitive functions throughout an individual's lifespan, from working memory to self-regulation. Assessment methods for inner speech vary based on research objectives. This project reviews and summarizes the prevalent themes and methodologies related to inner speech, focusing on multilingual environments and their influence on language choices. By exploring these contexts, the project aims to understand the factors influencing multilinguals' language choices for inner speech. Additionally, the project outlines a research plan for investigating language choice for inner speech in Hindi-English bilinguals, suggesting a potential preference for L2 in certain circumstances.
Goral Mashru	Synthesis of Bis(β-diketiminato) Ligated Transition Metal Complexes for Dinitrogen Fixation	Priyabrata Ghana	Chemistry	Nitrogen fixation is an important process for synthesizing compounds containing nitrogen. Since the Haber-Bosch process requires a large amount of energy due to its extreme reaction conditions, it is necessary to find an alternative method for nitrogen fixation. Our research is based on synthesizing organometallic ligands to

				catalyse this process. Following literature procedure, reactions for synthesis of two ethylene linked Bis(β-diketiminate) ligands with 2,6-diisopropylphenyl and 2,4,6-trimethylphenyl as the aromatic substituents were set up. However, the reactions did not proceed to completion.
Guntas Singh Saran	Generative Deep Learning for Computer Vision	Shanmuganathan Raman	Computer Science	The field of computer vision has experienced significant advancements over the past decade, largely due to the development and application of deep learning models. Among these, generative models have emerged as powerful tools capable of creating new data instances that resemble a given dataset. These models have wide-ranging applications, from image synthesis and inpainting to style transfer and data augmentation. Key types of generative models include Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), and Diffusion Probabilistic Models (DPMs).
Guntupalli Om Sravya	Food Analysis & Development: Protein and Micronutrient Rich Food Products	Bhaskar Datta	Biological Engineering	The goal is to develop a cost-effective and accessible technology that enables small scale food manufacturers to ensure product quality through color analysis. This project will use a machine learning-based classification model to know the food is consumable or not consumable, targeting to enhance product consistency, consumer satisfaction, and adherence to regulatory standards. In the food industry quality control is vital, yet small-scale manufacturers often lack the resources for advanced quality assurance technologies. Conventional methods, involving spectrometry and microscopy are expensive, therefore are

				not feasible for these producers due to the significant investment required. The proposed project addresses this gap by offering an alternative solution that leverages digital image analysis for quick and reliable food quality assessments without the need for expensive equipment. The project involves the development of a classification algorithm that utilizes color analysis of digital images to determine food quality. The research will begin with the collection of a diverse dataset of food images depicting various freshness levels and conditions. An algorithm will then be developed to extract and analyze color data from these images, identifying patterns indicative of spoilage or contamination. This data will be used to train a machine learning model that predicts the consumability of food items based on observed color characteristics. A user-friendly web interface will be designed using the StreamLit Python library, allowing users to upload images of food products and receive immediate quality assessments. This interface will be essential for providing accessibility to small-scale manufacturers, enabling them to conduct routine quality checks with ease.
Hansraj Verma	Development of Microscale chemistry experiments for STEM education	Manish Jain	Creative Learning	Practical exposure to chemistry enhances understanding and fosters analytical and critical thinking. However, in India, hands-on chemistry in schools is limited due to space, funding, safety issues, and teacher training. This research report addresses these challenges

				by developing microscale chemistry experiments for STEM education. Redesigned and optimized, these experiments include electrical conductivity studies, investigating the conductivity of various materials; microscale electrolysis of NaCl and $CuCl_2$, demonstrating electrochemical reactions; and electroplating of zinc on copper, elucidating the principles of electroplating. Additionally, detecting starch in food materials highlights chemical testing's everyday relevance, while flame tests and confirmatory cation tests offer hands-on analytical chemistry experience. The preparation of soap demonstrates saponification, observing $KMnO_4$ thermal decomposition fosters understanding of decomposition reactions, and preparing biodegradable plastic underscores sustainable practices. Finally, developing a puzzle on ionic bonds engages students through gamification. This comprehensive set of experiments provides a robust framework for STEM education, deepening understanding of chemistry through real-world applications, and will be integrated into chemistry kits for over 5,000 schools across India.
Harsh Gautam	Development of a Multimodal Elevator Control Interface	Yogesh K Meena	Computer Science	This project introduces an enhanced elevator interface that integrates voice recognition and eye-tracking for improved accessibility. Utilizing the Vosk model for speech commands and the Tobii Eye Tracker for gaze-based controls, the system

				features a minimalist black and white GUI designed for ease of use. Key functionalities include floor selection, door control, and emergency handling via voice and eye gaze. Challenges such as accurate audio input and reliable gaze detection were addressed through data augmentation and optimized calibration. Performance evaluation shows high command accuracy and quick response times, demonstrating the system's effectiveness in providing a seamless and intuitive user experience. Future work will focus on expanding voice command functionality, enhancing eye tracking accuracy, and supporting multiple users.
HARSH GUPTA	Catalytic asymmetric synthesis of 10α-hydroxy-Δ8-tetrahydrocannabinol	Chandrakumar Appayee	Chemistry	Cannabinoids are the class of biological compounds that binds the cannabinoid receptors. It has been observed that drugs containing cannabinoids may be helpful in treating certain rare forms of epilepsy, nausea and vomiting associated with cancer chemotherapy and loss of appetite and weight loss associated with HIV/AIDS. Several Cannabinoids such as Δ9-tetrahydrocannabinoid and cannabidiol (CBD) are useful in the treatment of side effects of cancer therapy. Cannabinoids function by stimulating two receptors, cannabinoid receptor type 1 (CB1) and type 2 (CB2), within the endocannabinoid system. The total synthesis starts from the methylation of olivetol followed by lithiation at 2 position which is stable due to chelation. Further the attack on the 1,2-butylene oxide to

				form 1-(2,6-dimethoxy-4-pentylphenyl) butan-2-ol. Further its asymmetric synthesis will be done to form the desired cannabinoids.
Harshita Kuntal	Modeling, Control, and Optimization of Complex Process Systems	Hari Ganesh	Chemical Engineering	This project aims to model and control complex processes using software and modeling tools like ASPEN Plus and ASPEN Plus Dynamics. It involves executing unit processes such as VLE (Vapor-Liquid Equilibrium), CSTR (Continuous Stirred-Tank Reactor), and various heat exchangers and reactors within a flowsheet.
Hetvi Vasava	Advancing Identification of Natural Food Colorants for Transparent Labeling and Consumer Safety	Bhaskar Datta	Biological Engineering	The increasing use of artificial food colorants has raised substantial concerns among consumers and regulatory bodies due to potential health risks and deceptive marketing practices. Synthetic colorants have been linked to health issues, prompting the demand for safer natural alternatives. However, food manufacturers often misleadingly label products as containing natural colors, even when using synthetic dyes like Rhodamine B, Allura Red, and Erythrosine B, complicating efforts for accurate product labeling and consumer safety. This research focuses on developing innovative differentiation methods using nanomaterial-based redox chemistry, leveraging copper nanoparticles to enhance colorimetric assessments. The target dyes for degradation experiments include three widely used synthetic dyes: Rhodamine B, Allura Red, and Erythrosine B, which are commonly used in various food, textile, and cosmetic applications. In addition, the study

				incorporates natural extracts such as beetroot to provide a comparative analysis of the degradation efficacy. The aim is to establish reliable techniques to distinguish between natural and synthetic colorants, supporting transparency and sustainability in the food industry and potentially influencing regulatory standards and practices.
Hritik	Dynamics Of Colloids in Quasi-two-dimensional Spatial Confinement	Chandan Kumar Mishra	Physics	Colloids are all around us, from the toothpaste to the smoke in the air, even the blood flowing through us. They have a diverse range of applications, from biological to material sciences. Recent studies have shown that the interactions between the particles and the suspended media differ greatly in 2D and 3D. The reduced dimensionality affects the interactions and dynamics, the relation between the colloids' diffusivity and the fluid's viscosity. In this work, we try to reproduce the findings reported in Nature Communication (2024) investigating the dynamics of colloidal fluids in quasi-2D spatial confinement. Subsequently, we would like to gain a better understanding of the connection between these long-ranged emergent interactions (hydrodynamics) and short-ranged inter-particle attractive potential.
Ishumael Nhambirwa	Laboratory determination of specific gravity and bulk density of minerals for determination of mineral tonnage	Rajkrishna Dutta	Earth Science	A thorough examination of the 'bulk and grain densities, porosity, and conversion factor' is included in the project report titled 'Laboratory determination of specific gravity and bulk density of minerals for determination of mineral tonnage'. The aim is to establish precise and reliable

				methods for quantifying the physical properties of mineral samples. These characteristics are vital for determining the tonnage of mineral deposits, which is required for resource estimation and economic appraisal in the mining sector. The study entails carefully assessing the bulk density, grain density, and porosity of diverse mineral specimens using advanced laboratory techniques. Bulk density is the mass-to-volume ratio of the total sample, including void spaces, whereas grain density is the mass-to-volume ratio of mineral grains, excluding pores. Porosity, calculated as the difference between these densities, represents the proportion of void spaces in the mineral matrix. The initiative uses methods like water displacement to ensure that the results are accurate and reproducible. By linking these physical properties to mineral composition and the geological environment, the study provides a complete framework for predicting mineral tonnage, improving resource assessment accuracy, and promoting sustainable mining methods.
Jaidev Sanjay Khalane	Exploring Pollen Biology of Indian Medicinal Plants using Computer Vision and Scanning Electron Microscopy	Subramanian Sankaranarayanan	Biological Engineering	To effectively analyze pollen samples from Indian Medicinal Plants, a comprehensive approach is required. Initially, the collection and scanning of pollen samples using Scanning Electron Microscopy will provide high-resolution images for detailed analysis. Subsequently, the creation of a database that is accessible worldwide will facilitate easy retrieval and sharing of the pollen images. Developing a user-friendly web application to showcase these images will

				enhance accessibility and usability for researchers and enthusiasts globally. Furthermore, the implementation of a sophisticated Computer Vision model for classifying the pollen images based on various features will enable accurate identification and categorization. By integrating these tasks seamlessly, a robust platform for studying and understanding Indian Medicinal Plant pollen samples can be established, contributing significantly to botanical research and beyond and therefore, leading to the creation of IMPORTANT database as well as the model PollenSEMNet.
Jayaprakash H M	Regressor-based potentials for high entropy alloys	Raghavan Ranganathan	Materials Engineering	The accurate and efficient modeling of interatomic potentials is essential in computational materials science. Traditional methods, such as empirical potentials sometimes fail in providing the complex behaviors of materials under various conditions. In recent years, machine learning is used in this field gto get highly accurate and transferable potentials. Among the many approaches Deep Potential Molecular Dynamics (DeepMD) and Machine Learning Interatomic Potentials (MLIP) have been successful. Machine-learning Interatomic Potentials are based on the idea of training a classical inter-atomic interaction model from the results of ab-initio calculations and using this model in practical simulations. The feature that distinguishes machine-learning potentials from semiempirical-based models is that their flexible functionality. DeePMD

				on the other hand is based on neural networks to fit potential energy models based on first-principles data. It can transform provided data into deep potential models, which can seamlessly interface with common molecular dynamics simulation software such as LAMMPS. DeePMD-kit can improve the calculation speed of molecular dynamics by several orders while maintaining the accuracy of quantum mechanics. Neural network has been the first and are probably the most popular form of regressor for machine-learning potentials. The other form of regressor is Gaussian approximation potentials (GAP), when used with the smooth overlap of atomic positions (SOAP) kernel, they can prov-ably approximate an arbitrary local many body interaction of atoms. Last one is based on linear regression with a set of basis functions. This includes the spectral neighbor analysis potential (SNAP) including the recent extension to multicomponent systems, and polynomial based ap-proaches including MTP which is the topic of our discussion. This is comparison study between these two approaches, in terms of their predictability, functionality and quickness. The system we are choosing for this is high entropy alloys because of its promising properties.
Joseph K Alex	Leveraging cognitive processes for	Meera M Sunny	Cognitive Science	Electric Vehicles (EVs) have been getting so popular these days and it started replacing

	acoustic vehicle alerting systems			almost all classes of vehicles. EVs are preferred more as they cause less air and sound pollution. However, these silent vehicles pose a severe threat to pedestrians or cyclists on a busy street because they would not be noticed as normal cars. Therefore, EVs should emit warning sounds to alert road users, complying with the safety regulations. This makes acoustic vehicle alert system (AVAS) technology critical for EVs. In this project, we will create a model to adapt AVAS to the underlying risk of accidents at the location of the vehicle. Our first attempt will be to estimate the risk associated with different sections of navigating paths by creating a high-resolution accident risk map based on satellite imagery, GPS trajectories, and real-time sensor data. We will use an end-to-end deep neural network to combine different data. Further, the model will be extended with the cognitive science models of attention and perception. The integration of cognitive science models of attention and perception will enhance the accuracy and effectiveness of our risk-adaptive AVAS technology. This interdisciplinary approach will provide insights into human behaviour and cognitive processes, allowing us to design warning sounds that effectively capture pedestrians' attention without causing unnecessary drive-by-noise. By developing an intelligent AVAS system that adapts to the risk level of different navigation paths, we can significantly reduce the likelihood of accidents involving EVs.

Joshi Neeraja Maulin	3D point cloud generation and completion	Shanmuganatha n Raman	Computer Science	This report documents my research and development activities during my two-month internship, focused on 3D point cloud generation and shape completion using diffusion models. It encompasses literature reviews, technical implementations, and experimentation with advanced algorithms and transformer models. The primary goal was to enhance the accuracy and efficiency of 3D point cloud processing methods, addressing the limitations of existing techniques. This report provides a comprehensive overview of my work, insights gained, and the outcomes achieved.
Kaila Uday Vardhan Reddy	Designing Catalyst for Selective Hydrogen Production on Formic Acid	Abinaya Sampath	Chemical Engineerin g	Hydrogen (H_2) is a clean and green energy source for the future. Among various H_2 carriers, formic acid (HCOOH) has garnered attention due to its high volumetric H_2 density, non-toxicity, and non-flammability, making it a promising option for H_2 storage. Pd-based heterogeneous catalysts provide higher rates for selective HCOOH dehydrogenation. However, the effect of Pd nanoparticle size on H_2 production from HCOOH over different supports is underexplored. In this work, we investigate the size sensitivity in H_2 production from HCOOH using ceria-supported Pd nanoparticles. The Pd nanoparticles sized 2.7 to 5.5 nm were synthesized using the polyvinylpyrrolidone (PVP) reduction method followed by impregnation on CeO_2. The Pd-CeO_2 catalysts were oxidized to remove the organic ligands and reduced to

				remove any oxide layer. The catalysts were tested in a batch reactor for aqueous HCOOH at ambient conditions. The produced gasses were quantified using gas chromatography, and the conversion was calculated using the volume of gas collected. The results demonstrated a volcano-type relationship between H_2 TOF from the HCOOH reaction and Pd nanoparticle size, presenting an optimal size range for maximum H_2 production.
Kailash Dusad	GEOD IITGN	Utsav Mannu	Earth Science	The GEOD Group Website project aimed to create a modern, responsive, and user-friendly online presence for the GEOD research group. This project involved developing a comprehensive website to showcase the group's research projects, datasets, publications, and team members. Utilizing a combination of React.js, React Bootstrap for the frontend, along with Node.js and Express for the backend, the website offers an engaging user experience and dynamic content management. Key features include an admin panel that allows for easy addition and updating of team members, research projects, datasets, and publications. Additionally, a contact form with email notification functionality ensures effective communication with visitors. This project successfully delivers a robust platform for the GEOD group to present their work, engage with the research community, and manage their online content efficiently.

Kambala.Chetan Teja	Mixed Signal In Memory Computing	Joycee Mekie	Electrical Engineering	This research introduces an innovative 6T SRAM cell-based bit-parallel and bit-serial in-memory computing (IMC) architecture designed to support a variety of computations with reconfigurable bit-precision. Traditional digital IMC methods have shown potential but are often hindered by a trade-off between area efficiency and energy consumption. Analog IMC approaches, while promising, struggle with issues related to noise tolerance and precision. This study investigates the performance differences between bit-serial and bit-parallel IMC architectures that leverage 6T SRAM cells to perform computations within the memory array. Comprehensive evaluations highlight the advantages and limitations of each approach, demonstrating that mixed-signal IMC using 6T SRAM cells can achieve significant improvements in energy efficiency and computational throughput for AI workloads. Additionally, the study addresses the memory wall bottleneck, presenting a compelling case for the adoption of mixed-signal IMC in future high-performance computing systems. The results underscore the potential for this architecture to revolutionize energy-efficient, high-throughput AI processing.
Kaxit Pandya	Post-processing of atomistic simulation data using python and setting up a deep-learning model for inverse design of 2D materials based heterostructure	Tarun Kumar Agarwal	Electrical Engineering	The integration of two-dimensional (2D) materials with Artificial Intelligence (AI) has garnered significant attention due to the unique properties of 2D materials and their potential

				applications in various fields. Atomistic simulations play a vital role in understanding these materials properties and behaviours at the atomic scale. However, extracting meaningful insights from large volumes of simulation data poses a challenge. This project aims to address this by developing a Python-based code for post-processing atomistic simulation data and setting up a deep learning model for the inverse design of 2D material-based heterostructures.
Keerthana G	Effect of small molecules on biological system to develop novel therapeutics	Sivapriya Kirubakaran	Chemistry	Cancer remains a formidable challenge in modern medicine, characterized by uncontrolled cell growth and proliferation that can invade surrounding tissues and metastasize to distant organs. The general methods for treatment of cancer like Chemotherapy and Radiotherapy are based on induction of DNA damage in cancer cells. But cancer cells develop resistance to these treatments by DDR (DNA Damage response) pathways. Ataxia Telangiectasia and Rad3-related (ATR) kinase inhibitors have emerged as promising candidates in cancer therapy due to their ability to disrupt the DNA damage response (DDR) pathway, a critical mechanism for cancer cell survival and resistance to treatment. ATR kinase plays a pivotal role in orchestrating DDR by sensing DNA damage and activating downstream signaling pathways, ultimately leading to cell cycle arrest, DNA repair, or Apoptosis.Torin2, is an ATP-competitive mTOR and ATR Kinase inhibitor displays a considerable pharmacokinetic and pharmacodynamic traits.

				SPK-98, a promising analog of Torin 2, exhibit appreciable microsomal stability thereby acting as a pharmacological tool to explore the therapeutic potential of ATR/mTOR inhibitors in treatment of colon cancer. Our current study focuses on designing and synthesizing the analogs for SPK-98 molecules to improve its solubility and selectivity towards ATR kinase.
Kerman Zaveri	Investigating Three-Body Decays In The Three Higgs Doublet Model	Baradhwaj Coleppa	Physics	The Three Higgs Doublet Model (3HDM) is an extension of the Standard Model (SM), incorporating two additional Higgs doublets. The 3HDM introduces eight new scalar particles that provide richer phenomenology. Here, the study aims to explore potential experimental signatures of the 3HDM by identifying three-body decays unique to this model. This requires deriving the general decay width formula, calculating maximum decay widths in Mathematica, and determining the branching ratios with the help of Madgraph5_aMC@NLO for two cases having different mass ranges. The results indicate that the exceedingly low branching ratios make the detection of these decays challenging at the Large Hadron Collider (LHC).
Khyatee Nareshbhai Kakadiya	POC/Prototyping of Pneumatic Hand Glove for Finger Joint Rehabilitation		Maker Bhavan	Soft robotics has the potential to revolutionize the medical device industry and helps patients in doing tasks more efficiently which in contrast would be difficult for them to perform without assistance. Our project focused on developing a soft-robotics based pneumatic hand glove prototype which can be used to assist patients in rehabilitation exercises and

				recovery. The fabrication of the pneumatic actuators was done using silicon rubber which is often used in soft-robotics application. The molds were designed separately for each finger so as to match different finger sizes. The design of the actuator was inspired from the PneuNets bending actuator. We performed testing to measure the load bearing capacity. Various objects were held using the glove and it provided support for objects weighing up to 200g. Moreover, analysis of the actuators was done using different open-source software and tools to check for its efficacy.
Kiruthika C	Effect of small molecule on biological systems to develop novel therapeutics	Sivapriya Kirubakaran	Biological Engineering	TLK (Tousled-like kinase) belongs to a family of serine/threonine protein kinases play important roles in fundamental cellular processes such as chromatin remodelling, DNA repair, and transcriptional regulation. TLK plays a crucial role in cellular processes such as chromatin remodelling and DNA repair. They play an important role in maintaining genome stability and are implicated in diseases such as cancer when their function is disrupted. Thus, this reports mainly focusses on protein expression and purification of TLK. Understanding their biochemical properties and molecular functions requires efficient methods for protein expression and purification. Recombinant protein expression of TLKs involves cloning the TLK gene into suitable expression vectors and expressing them in heterologous systems such as

				bacteria, yeast, or mammalian cells. The choice of expression system depends on the desired posttranslational modifications and downstream applications. Subsequent protein purification utilizes various chromatographic techniques, including affinity chromatography such as Ni-NTA chromatography, which exploits the poly histidine (His-tag) affinity tag fused to TLK proteins for selective purification. Additional purification steps may include ion exchange chromatography and size exclusion chromatography to achieve high purity and yield. This abstract summarizes the strategies and significance of recombinant protein expression and purification of TLK proteins.
Krishna Kant Singh	Performance of Omega-Tuned Range-Separated Functionals Versus B3LYP-D in Predicting Organic Semiconductor Properties	Anirban Mondal	Chemistry	This study investigates the performance of 25 experimentally reported donor-acceptor-donor (D-A-D) molecules using four density functional theory (DFT) methods: WB97XD, B3LYP-D3, B3LYP-D3BJ, and M062X. The primary aim was to compare these functionals against a tuned WB97XD functional to identify a cost-effective alternative that yields results closely aligned with experimental data. We calculated vital properties, including HOMO and LUMO energies, energy gaps, and absorption and emission wavelengths, establishing benchmarks for performance evaluation. While the tuned WB97XD provided high accuracy, its computational cost was significant. Although less computationally demanding, the alternative

				functionals delivered reasonably accurate predictions, suggesting their viability for initial research phases. This research highlights the importance of balancing computational efficiency with accuracy in studying thermally activated delayed fluorescence emitters for organic light-emitting diodes (OLEDs), offering insights into the practical application of D-A-D molecules in OLED technology.
L.Kamaleshwaran	Asymmetric organocatalysis	Chandrakumar Appayee	Chemistry	The introduction of a trifluoromethyl group (-CF_3) into organic molecules, has emerged as a pivotal tool in modern synthetic organic chemistry.1 The unique properties of trifluoromethyl groups, characterized by their electron-withdrawing nature and high lipophilicity, provide compounds with enhanced stability, bioactivity, and potential for diverse applications across pharmaceuticals, agrochemicals, and materials science.2 Consequently, the development of efficient and selective methods for trifluoromethylation represents a significant frontier in organic synthesis research. In the view of conjugate radical addition reactions, α,β-unsaturated aldehydes (enals) as a substrate are not much explored because of electron poor nature of olefinic double bond. We propose conjugate trifluoromethylation of enals using Togni's reagent via copper catalysis. Our main focus will be on α-aryl enals as model substrate for trifluoromethylation to obtain

				α-aryl β-trifluoromethyl aldehydes.
Lavi	Synthesis of fluorescent dye intermediate	Sriram Kanvah Gundimeda	Chemistry	We aim to synthesize triple-bonded fluorophores through Sonogashira and Hyama coupling reactions. Sonogashira and hyama coupling reaction form carbon-carbon bonds of aryl alkyl and aryl halide crucial for constructing the triple-bonded fluorophore. The condensation reaction extends the conjugation, enhancing fluorescent properties. Finally, methylation reactions modify and optimize the photophysical characteristics of the fluorophore.
Mamta Bhambhani	Designing And Modelling A Bidirectional Dc-Dc Converter For V2g Charging	Pallavi Bharadwaj	Electrical Engineering	V2G technology plays a crucial role in achieving clean energy objectives, such as the goal of zero-carbon emissions. Additionally, it offers potential financial benefits to consumers by reducing the overall cost of electric vehicle ownership.
Mansi Pawar	Effect of small molecules on biological system to develop novel therapeutics	Sivapriya Kirubakaran	Chemistry	Molecule 1: Reaction 1 involved the formation of an acid-HATU complex, followed by the addition of 2-chloroaniline. The reaction mixture underwent standard workup procedures, including separation using ethyl acetate and NaCl, followed by column chromatography with 25% ethyl acetate/hexane. The product was characterized by NMR, confirming the formation of the desired compound. Reaction 2 included the preparation of an amide, followed by treatment with KOH and the addition of a morpholine linker. The reaction was monitored via TLC and quenched after 48 hours. Post-workup, the product was isolated and

				characterized by mass spectrometry and NMR. Molecule 2: Reaction 1 similarly involved the formation of an acid-HATU complex, with 2-fluoroaniline as the reactant. After workup and separation using 20% ethyl acetate/hexane, the product was confirmed by NMR. Reaction 2 involved the amide product from the previous step, treated with KOH and a morpholine linker. The reaction was monitored, quenched, and the product was isolated for characterization by NMR and mass spectrometry. Molecule 3: Reaction 1 followed the same initial procedure as Molecule 1, with 2-chloroaniline as the reactant. The product was separated using 25% ethyl acetate/hexane and confirmed by NMR. Reaction 2 involved the prepared amide treated with KOH and a chloroethyl pyrrolidine linker. The reaction was monitored, quenched, and purification is done and formation of required product is confirmed by NMR and Mass. Molecule 4: Reaction 1 followed the initial procedure as Molecule 2, with 2-fluoroaniline as the reactant. The product was separated using 20% ethyl acetate/hexane and confirmed by NMR. Reaction 2 involved the amide treated with KOH and a chloroethyl pyrrolidine linker. The reaction was monitored, quenched, and is currently

				undergoing purification. Each reaction step was meticulously monitored, and products were characterized using TLC, NMR, and mass spectrometry to confirm the desired molecular formations. This comprehensive approach ensures the reliability and reproducibility of the synthesized molecules for further applications.
Maulik Moradiya	Recovery of pigments and oils from floral waste using hot pressurized water	Sameer Dalvi	Chemical Engineering	This report details the research conducted on efficiently extracting bioactive compounds from marigold and rose petals using subcritical water extraction (SWE). This method employs hot pressurized water as a solvent-free approach to recover valuable pigments and oils from floral waste. The research includes an exploration of process parameters, post-processing methods, and analytical techniques to evaluate the efficiency and outcomes of the extraction process.
Mayank Pachauri	Mixed Signal In-Memory Compute (IMC)	Joycee Mekie	Electrical Engineering	This research introduces an innovative 6T SRAM cell-based bit-parallel and bit-serial in-memory computing (IMC) architecture designed to support a variety of computations with reconfigurable bit-precision. Traditional digital IMC methods have shown potential but are often hindered by a trade-off between area efficiency and energy consumption. Analog IMC approaches, while promising, struggle with issues related to noise tolerance and precision. This study investigates the performance differences between bit-serial and bit-parallel IMC architectures that leverage 6T SRAM cells to perform computations within

				the memory array. Comprehensive evaluations highlight the advantages and limitations of each approach, demonstrating that mixed-signal IMC using 6T SRAM cells can achieve significant improvements in energy efficiency and computational throughput for AI workloads. Additionally, the study addresses the memory wall bottleneck, presenting a compelling case for the adoption of mixed-signal IMC in future high-performance computing systems. The results underscore the potential for this architecture to revolutionize energy-efficient, high-throughput AI processing.
Mihika Desai	True Stiffness Estimation Set-up and Smack and Grab 2-finger robot	Harish P M	Mechanical Engineering	Under the topic of Robots that learn on their own through physical interaction with the environment, I had built a setup that could measure the stiffness various objects which also include day to day stuff like fruits and vegetables who's stiffness widely varies for each particular one. This stiffness calculates could be used by leap hand and other different robots for grasping and also performing other functions.
Mohit Maurya	Develop a respiration sensing system in SmartWatch.	Nipun Batra	Computer Science	Our work is based on the original paper by Adhikary, Rishiraj, et al., titled "JoulesEye: Energy Expenditure Estimation and Respiration Sensing from Thermal Imagery While Exercising." Under the guidance of Prof. Nipun Batra and as part of the SRIP initiative, our team has focused on developing a smartwatch capable of extracting respiration signals using a thermal camera. The project aims to create a compact, wearable device for

				real-time respiration rate monitoring, with significant applications in health diagnostics. Key challenges, such as the thermal camera's low refresh rate and resolution, were addressed through hardware modifications and image preprocessing techniques. Initial bulky prototypes validated the concept, while ongoing efforts concentrate on miniaturization and improved accuracy. Future work includes enhancing respiration rate detection algorithms and integrating machine learning models for automatic nostril detection. This report outlines the project's progress, challenges, solutions, and future directions, highlighting the potential impact of the Joules Eye smartwatch on health monitoring technology.
Muhammad Zaid Hassan	Air quality forecasting with machine learning with LLMs	Nipun Batra	Computer Science	This project investigates the potential of Large Language Models (LLMs) in the domain of air quality forecasting, highlighting their strengths, limitations and the techniques used to enhance their predictive accuracy. LLMs are built on the transformer architecture and trained on vast internet datasets to excel in natural language processing tasks. Their ability to tokenize and embed input words into vector spaces allows for sophisticated next-word predictions, making them versatile tools in natural language applications. Air quality prediction is vital for public safety, providing timely warnings during events like wildfires or industrial accidents, and for enhancing environmental research. The report examines the advantages of LLMs, including

				their zero-shot capabilities and efficient tokenization through binning. Techniques like temperature and multi-sampling further improve the stability and accuracy of predictions. Chain-of-Thought prompting has also shown promising improvements. Results indicate that methods such as TimeInPrompt, which incorporates temporal knowledge, perform well, while traditional statistical models remain more reliable. However, LLMs face challenges in representing sequential dependencies and are not yet effective for zero-shot time-series forecasting. Future work could focus on investigating the integration of spatio-temporal knowledge to improve their performance. Despite current limitations, LLMs hold promise for advancing air quality forecasting with further refinement and innovation.
Mulakala Gowthami	Machine learning based battery lifetime estimation	Pallavi Bharadwaj	Electrical Engineering	This research focuses on developing a robust and accurate model to predict the remaining useful lifetime (RUL) of batteries which is a critical aspect in enhancing the reliability and efficiency of energy storage systems. The study integrates machine learning algorithms with real-time battery health monitoring data to create a predictive framework capable of estimating battery RUL under various operational conditions. We employ a dataset encompassing diverse battery chemistries, usage patterns, and environmental factors to train and validate our model. An Ensemble based Learning method is used to fit the data. The models in the ensemble training include Support

				Vector Regressor (SVR) and Random Forest models were used to train the non-linear data and also long-term dependencies. The results of this model include 0.0022 of validation loss. This predictive capability is crucial for optimizing maintenance schedules, reducing downtime, and extending battery life, thus contributing to the sustainable development of energy storage technologies.
Nakabuye Flavia Emily	Food Analysis & Development: Protein and Micronutrient Rich Food Products	Bhaskar Datta	Biological Engineering	This report outlines research focused on developing nutritious millet-based baked goods and analyzing acrylamide content. The project involved creating brownies, cookies, and muffins using various millet flours, with emphasis on ingredient optimization for health benefits. Three brownie variations were developed to explore the effects of flour source, cocoa intensity, sweetness, and fat content. The analytical component employed enzyme hydrolysis reactions for acrylamide analysis, utilizing both enzyme-assisted extraction and conventional solvent methods. While acrylamide mitigation was not completed, the work provided valuable insights into food product development and analytical techniques, including HPLC and LC/MS. This research contributes to the growing field of alternative grain utilization in baked goods and food safety analysis.
Nayan Garg	QPyTorch++ Leveraging the Fixed Posit Number System for training of Neural Networks and GANs	Joycee Mekie	Electrical Engineering	The posit number system, introduced as an innovative alternative to the IEEE standard single and double precision numbers, features a dynamic ”regime field” in its bit repre- sentation. With a run-

				length encoded value (k), this regime field works alongside a useed value defined as 22es . By raising the useed to the power of k and multiplying it with the rest of the number, posits achieve a more excellent dynamic range than floats of the same bit size. However, the dynamic nature of the regime field complicates hardware implementation due to the need to accommodate all possible encoding cases, thus increasing hardware complexity and requirements. To address these challenges, the Fixed Posit number system was developed. By fixing the size of the regime field, Fixed Posit mitigates the hardware complexity issues while maintaining the advantages of posits, particularly in terms of area and power efficiency for error-resilient applica- tions. This project aims to develop an infrastructure that accelerates Fixed Posit number system research by enabling easy training of neural networks using fixed posit quantizations.
Neerja Kasture	Optimizing BERT: Comparative Analysis of SIMBA and Novel Architecture	Joycee Mekie	Electrical Engineering	This project explores the optimization of BERT, a NLP model by comparing the performance and energy efficiency of the Simba architecture with a novel proposed architecture. BERT is modeled using Timeloop and Accelergy tool which estimates energy of all operations involved and outputs the most optimal mapping of the problem on the hardware used. The novel architecture, featuring a streamlined design and reduced precision operations, shows substantial improvements in energy efficiency, area and latency

				compared to SIMBA. The report also delves into the impact of different numerical precisions on BERT's performance, demonstrating that lower precision numbers can maintain acceptable accuracy while obviously reducing energy used. Thus, this project demonstrates the potential of designing hardware accelerators for enhancing the efficiency of inference on NLP workloads such as BERT.
Netram Choudhary	Development of a Real-Time Assistive Typing Mobile Application with CNN and OpenCV-Enhanced Server	Yogesh K Meena	Computer Science	This report presents the development of a Flutter application designed to facilitate real-time typing using a virtual keyboard. The application integrates several advanced technologies, including convolutional neural networks (CNN) for predictions, OpenCV for image processing, and a Flask server for backend processing. The application achieves high accuracy in calibration and provides an efficient user interface for typing through real-time communication using SocketIO.
Nikhilesh Myanapuri	Digital Implementation and Evaluation of Oscillatory Neural Networks	Sandip Lashkare	Electronics	The exponential growth of data challenges traditional Von Neumann computing paradigms, necessitating the exploration of novel approaches such as Oscillatory Neural Networks (ONNs). This project explores the digital implementation of ONNs of various sizes on FPGA, assessing their speed and efficiency in pattern recognition tasks
Nimitt	Prediction of intermediate etching/deposition profiles using RNN/PINN/GPR	Nihar Ranjan Mohapatra	Electrical Engineering	Optimal etching requires finely tuned parameters, typically determined through costly and time-consuming experiments or TCAD simulations. This research aims to develop a predictive deep learning

				model to accurately forecast intermediate profiles during etching, offering a faster and more reliable method for process control and optimisation in semiconductor manufacturing.
Nirjara Mehta	Analysis of 2 DEG Profile and Strain Propagation in AlScN/GaN based Heterostructures	Jhuma Saha	Electrical Engineering	In this report, we present a comparison between the standard AlGaN/GaN-based HEMTs and AlScN/GaN-based HEMTs to display the improvement in the electron density and electric field in the 2 DEG. The proposed use of AlScN as a barrier layer is backed by its ferroelectric property of AlScN, which enables it to change the direction of polarisation and store charge, which can account for the 2 DEG. The simulations performed on NextNano software are consistent with the results previously obtained in other researches.
Nirman Jaiswal	Nucleosite - A nuclear siting Dekstop Application	Sushobhan Sen	Civil Engineering	NucleoSite is an innovative desktop application designed to optimize the site selection process for nuclear power plants across India. Leveraging the PyQt5 framework, the application offers interactive geographical visualizations, allowing users to explore potential nuclear sites with a focus on dam locations within various states. Inspired by the Oak Ridge Siting Analysis for Power Generation Expansion (ORSAGE), NucleoSite is tailored to address India's unique geospatial and infrastructural challenges. The application supports building of an even greater network of nuclear energy in India as well ad India's transition from coal-fired to nuclear power by providing comprehensive visual assessments based on environmental, geological,

				and infrastructural parameters. Key features include interactive map visualization, dynamic reporting, data analysis tools, and customizable search parameters. Developed using Python, PyQt5, Matplotlib, GeoPandas, and FPDF, NucleoSite facilitates detailed risk assessments and infrastructure planning. This project represents a significant step towards sustainable energy development in India, providing essential tools for informed decision-making in nuclear site selection.
Nischay Patel	DNA barcoding of Indian Medicinal plants	Subramanian Sankaranarayanan	Biological Engineering	DNA barcoding, a robust tool for species identification, holds significant promise for enhancing authenticity and quality control in herbal and Ayurvedic medicines. The traditional methods, often time-consuming and impractical for industrial-scale applications, are complemented by DNA barcoding, which offers efficient and reliable plant species identification. However, the identification of the subspecies or variants within species is a difficult task and has challenges due to higher sequence similarity for marker genes and correct identification of variants. This research presents a comprehensive methodology for DNA barcoding in three variants of common medicinal plants, namely, Bougainvillea, Dianthus, and Plumeria, using the matK as a molecular marker. The sequenced matK regions with 500-700 bp size have a variability of approximately 1 to 2.7% among inter and intra-species variants, facilitating the easy identification of the species

				through high-quality barcodes. The sequence and phylogenetic analysis revealed that our sequences were clustered with the matK genes of closely related species. The two-dimensional barcodes generated for the nine inter and intra-species variants direct to deposited matK nucleotide sequences at NCBI when scanned. Our findings underscore the potential of DNA barcoding as a powerful tool for the identification and authentication of inter and intra-species variants over conventional means.
Nishi Shah	Photovoltaic System Modeling and Partial Shading Analysis	Pallavi Bharadwaj	Electrical Engineering	This report summarizes the modelling of photovoltaic cells via parameter extraction. Also, the study of methods for changing operating points on the I-V curve of photovoltaic (PV) systems which includes simulations of different DC-DC converter methods. Further study is done to analyze the effects of partial shading and address the challenges posed by it.
Om Gupta	NucleoSite	Sushobhan Sen	Civil Engineering	NucleoSite is an advanced desktop application developed to enhance the site selection process for nuclear power plants across India. Utilizing the robust PyQt5 framework, this application provides interactive geographical visualizations that allow users to explore dam locations within various states. With features inspired by the Oak Ridge Siting Analysis for Power Generation Expansion (OR-SAGE), NucleoSite is specially adapted to address the unique geospatial and infrastructural challenges faced in India

Omisha Guha	JoulesEye Prototype: Respiration Sensing from Thermal Imagery	Nipun Batra	Computer Science	JoulesEye is an innovative smartwatch prototype designed to monitor respiration signals using thermal imaging. This study explores the feasibility of using a low-resolution thermal camera integrated with a microcontroller to detect and monitor breathing patterns. This project addresses key gaps in real-time processing, focusing on reducing startup time, optimizing computational efficiency and minimizing processing latency.
Ompriya Pradhan	Protein Purification And Expression With Structural Analysis of GSAP	Vijay Thiruvenkatam	Biological Engineering	This research investigates GSAP (gamma secretase activating protein), a crucial regulator implicated in Alzheimer's disease pathology. The study focused on GSAP expression and purification to elucidate its structural characteristics using advanced analytical techniques. Protein Purification of GSAP was done using the process of lysis, column, wash and eluted proteins were collected. SDS-PAGE analysis confirmed the presence of a single band corresponding to GSAP's molecular weight, while the Bradford assay quantified its concentration accurately. To further characterize GSAP, native PAGE was employed to assess its native oligomeric state, complemented by non-reducing PAGE to confirm the absence of disulfide bonds. Structural prediction using AlphaFold was pivotal, involving multiple sequence alignment (MSA) and evaluation metrics such as predicted local distance difference test (PLDDT) and predicted aligned error (PAE)

				plots. These analyses provided a detailed three-dimensional model of GSAP's structure with high confidence, facilitating insights into its functional domains and potential interaction interfaces crucial for understanding its role in gamma-secretase activation. Overall, this integrated approach of protein expression, purification, and structural analysis offers valuable insights into GSAP biology, particularly its relevance to Alzheimer's disease pathology. The findings not only contribute to the fundamental understanding of GSAP's molecular mechanisms but also lay a foundation for future therapeutic strategies targeting gamma-secretase activation in neurodegenerative diseases.
Pallavi	Development Of A Low Cost Eeg Device To Actuate External Device Using Ssvep Interface	Krishna Prasad Miyapuram	Cognitive Science	This report details the development and evaluation of a low-cost, two-channel EEG-based Brain-Computer Interface (BCI) system utilizing Steady-State Visual Evoked Potentials (SSVEP) for external device control. We designed a custom EEG device targeting frontal cortex signals, integrated with a novel SSVEP stimulation interface. Our goal was to demonstrate that effective BCI control can be achieved using minimal channels and affordable components for external device control. The system incorporates a carefully designed visual stimulation paradigm, featuring checkerboard patterns with varying spatial frequencies and flicker rates. Advanced signal processing techniques and machine learning algorithms were

				employed to maximize information extraction from the limited frontal EEG data. We rigorously assessed the system's performance through a series of experiments involving multiple participants, evaluating its efficacy in terms of classification accuracy, information transfer rate, and practical device control capabilities.
Pankaj	Automated Waste Classification System	Hari Ganesh	Chemical Engineerig	The project aims to develop an automated waste classification system that classifies municipal solid waste (MSW) into different classes, so that it can be treated accordingly. In this project waste is classified into one of these six categories - paper, plastic, metal, glass, organic and trash. Deep learning and computer vision techniques are used to achieve the aim. A pre-trained EfficientNet model was used for the task. The pre-trained model was fine-tuned using transfer learning to give output as one of the six classes. After employing the model, it was tested on a real-world test dataset created by us. To train the model, a diverse dataset was used which was made up of a combination of 5 different garbage/waste datasets available online and a total of around 50000 images. This model is intended to be deployed on a conveyor belt system in which waste is put on the belt and a camera captures an image of the waste, which then is classified into one of the categories. Then using a tool such as an airgun can be used to push the waste into the desired bin for the waste. In this report details about methodology, implementation and results are presented.

Parag Sarvoday Sahu	Implementation of lock-in amplifier on an FPGA board	Arup Lal Chakraborty	Electrical Engineering	An implementation of a lock-in amplifier (LIA) with fixed internal reference signal generation at the frequency of 8 kHz and 16 kHz on a Nexys 4 DDR FPGA board is demonstrated. An attempt to enable high-speed transfer of lock-in detected data to a Raspberry Pi for real-time wavelength modulation spectroscopy (WMS) based ambient gas concentration is also described. The satisfactory working of FPGA-based LIA could not be verified as the transfer of lock-in detected data from FPGA is still a work in progress.
Parikshit Modi	Development of C2-Symmetric Chiral Bicyclic Secondary amine Organocatalysts and their Application to Vinylogous Functionalization of Aldehydes	Chandrakumar Appayee	Chemistry	Organocatalysis emerged as the third pillar in asymmetric catalysis alongside metal and enzyme catalysis. Pyrrolidine-based chiral secondary amines are fantastic catalysts for the vinylogous functionalization of aldehydes. This field still suffers challenges, including high catalyst loading, difficult purification, and limited recyclability. While polymer-supported catalysts partially address some of these issues, they still suffer from degradation by silyl group detachment or endocyclic imine formation modes. This research addresses these issues and proposes a silyl-free bicyclic organocatalyst with a pyrrolidine core. The proposed catalyst exhibits C2 symmetry, which is crucial as it allows for enamine and iminium formation on both sides of the molecule. This symmetry enables incoming electrophiles and nucleophiles to approach from multiple directions without compromising enantioselectivity, ensuring highly selective aldehyde

				reactions in the synthesis of chiral molecules. The aim is to synthesize it and explore its potential in aldehyde functionalization and polymer-supported applications. This work contributes to green chemistry principles, offering efficient, non-degradable organocatalysis for various industrial applications.
Parneet Saini	Design and Development of Hands-on Integrated STEM Workshop Materials	Manish Jain	Creative Learning	This final report summarizes my internship at IIT Gandhinagar, focusing on the design and development of hands-on integrated STEM workshop materials. The project aimed to innovate STEM education through interactive learning models and comprehensive documentation. Key contributions include developing puzzles like the Polyomino Puzzle, Soma Cube, and Tikone Phool, which enhance spatial reasoning, creative problem-solving, and pattern recognition. I also explored Pythagorean Theorem Verification Activities and documented various educational manuals to facilitate hands-on learning. The supportive mentorship and collaborative environment at CCL significantly enriched my experience, enhancing my technical skills, instructional design capabilities, and understanding of effective STEM education strategies. The insights gained during this internship will inform future efforts in creating engaging and impactful STEM learning resources.
Parth Ganesh Dangi	A Novel BCI Classifier for Classification of Multi-Class Motor Imagery Data	Krishna Prasad Miyapuram	Cognitive Sciences	This research proposes a novel Brain-Computer Interface (BCI) system for classifying multi-class motor imagery data using task-related component analysis

				(TRCA). The system significantly improves classification accuracy, particularly for hand movements, and demonstrates the potential for accurate finger movement identification and exploring movement vividness through observed parietal activation. These advancements promise more precise and versatile BCIs for rehabilitation, prosthetics, and virtual reality applications.
Parul Saxena	Effect of small molecules on biological system to develop novel therapeutics	Sivapriya Kirubakaran	Chemistry	Human African Trypanosomiasis (HAT), Chagas disease (CD), and leishmaniasis are severe protozoan diseases categorized as Neglected Tropical Diseases (NTDs) by the WHO, affecting millions in tropical regions and increasingly spreading due to global human activities. Current treatments for these diseases pose significant challenges, as they rely on highly toxic substances such as arsenic for HAT and antimonials for leishmaniasis. These treatments have severe side effects and are becoming less effective due to increasing resistance. Inspired by DNDi's high-throughput screening, we aim to design and synthesize analogs based on the lead compound DNDI0003202883, focusing on benzoxazole amides for their broad-spectrum activity against Kinetoplastid parasites. By exploring the structure-activity relationship, we will investigate how different substituents impact the biological activity and effectiveness against Leishmania donovani and Trypanosoma cruzi. This research seeks to build on the

				initial discovery of promising antiparasitic agents, enhancing their potential for therapeutic use.This study focuses on synthesizing novel Benzoxazole amide derivatives to investigate their structure-activity relationship (SAR) and improve efficacy. Inspired by DNDi's high-throughput screening campaign, the research explores the effects of adding halogens and methoxy groups at the C5 position and replacing the phenyl group with other moieties. Synthetic methodologies involve synthesis of aminobenzoxazole and subsequent amidation, with characterization using NMR and mass spectrometry that confirms the structural data. These efforts aim to develop safer, more effective treatments for kinetoplastid diseases, addressing a critical need in global health.
Poorani M	Modelling, Control And Optimization Of Complex Processes	Hari Ganesh	Chemical Engineering	In the realm of chemical engineering, the modeling, control, and optimization of complex systems are pivotal for enhancing process efficiency, safety, and sustainability. This project delves into advanced methodologies for accurately modeling chemical processes, developing robust control strategies, and optimizing operational parameters. By leveraging state-of-the-art mathematical and computational tools, we aim to address the intricate dynamics of chemical reactions, transport phenomena, and multi-phase interactions. The integration of predictive modeling and real-time control mechanisms enables precise regulation of critical variables, such as temperature,

				pressure, and concentration, thereby ensuring optimal performance. Through case studies and simulation-based approaches, we demonstrate the application of these techniques in optimizing reactor design, process scale-up, and energy utilization. The findings underscore the importance of a holistic approach in managing complex chemical systems, ultimately contributing to improved process reliability, reduced environmental impact, and enhanced economic viability. This work represents a significant step forward in the pursuit of innovative solutions for the chemical engineering industry.
Pracheta Mitra	Development of Indigenous Low-Cost Particulate Matter Sensor	Sameer Patel	Civil Engineering	PM sensors measure the concentration of particles suspended in the air. These particles can come from various emission sources such as vehicle emissions, industrial processes, construction activities, etc. By monitoring PM levels, we can assess air quality and understand the extent of pollution in a particular area. PM sensors play a vital role in monitoring air quality, protecting public health, ensuring compliance with environmental regulations, understanding climate change impacts, and identifying sources of pollution. To eliminate the need for complex on-board algorithms and make the sensor easier to understand and use, a low-cost version of PM sensor which measures raw voltage values can be designed. Users will have the flexibility to apply their own algorithms and calibrations according to their specific needs and contexts

				and also have more knowledge and control over output.
Pranav Menon K	Modelling the mechanical response of self-healing materials	Harini Subramanian	Mechanical Engineering	Self-healing materials have the ability to heal damage autonomously or with external intervention, enabling the material to recover its mechanical integrity. The objective of this project is to analyse the stress-strain relationships for viscoelastic self-healing materials. The viscoelastic response will be captured using mechanical analogue models and coupled with damage and healing evolution, using continuum damage healing mechanics. The present work will focus on exploring different mechanical analogue models of polymers, understand how each model captures the mechanical response of different viscoelastic materials, and introduce the idea of damage and healing in each model. The stress-strain relationship obtained in the damage-healing model will be analysed to understand the advantages and limitations of different mechanical analogue models in capturing damage-healing in a self-healing viscoelastic material. Experimental development of self-healing materials and their testing has been done in the recent literature but theoretical models for predicting the healing of damage in materials are very limited. To this end, failure and recovery will be considered in the mesoscale of the polymer in order to average out the effects of all the failure mechanisms in the microscale through two variables called damage and healing variables.

				Experimentally motivated evolution equations for damage and healing will be adopted which will be phenomenological and dependent on the material being modelled. In case of implicit equations, Newton-Raphson technique will be used for obtaining the solution. The obtained solutions can be utilized to further develop three-dimensional relations that can be integrated into commercial analysis software through user-subroutines in the future.
Pranav Sharma	Alloy catalyst synthesis and characterization for hydrogen production	Abinaya Sampath	Chemical Engineering	Meeting the escalating demand for renewable and environmentally friendly energy sources has become imperative for our ecosystem. Molecular hydrogen (H_2) stands out as a promising candidate for clean energy generation, particularly in fuel cells, offering the potential to produce electricity efficiently. However, the practical challenges surrounding its transportation and storage hinder its widespread adoption. Utilizing methanol as a carrier for hydrogen presents a viable solution, given its high hydrogen content (12.6%) and liquid state at room temperature. Harnessing methanol for effective H_2 production could propel us towards a "Methanol Economy," mitigating the complexities associated with hydrogen transportation and storage. While methanol can undergo oxidation to yield formaldehyde and formic acid, traditional methanol-reforming processes demand high energy input, typically operating at temperatures exceeding 200°C and high

				pressures. Our motivation stems from the quest to develop a more energy-efficient method for H_2 production, operating at temperatures below 100°C and atmospheric pressure, utilizing methanol as a precursor. Crucially, the choice of catalyst plays a pivotal role in determining the mechanism leading to H_2 formation from formic acid, rather than H_2O.
Prateek Sarkar	Synthesis of Fluorescent dyes	Sriram Kanvah Gundimeda	Chemistry	The synthesis of fluorescent dyes is a pivotal field in chemical and biological sciences, focusing on the creation of compounds that emit light upon excitation by specific wavelengths. These dyes are synthesized through various organic reactions, often involving the formation of conjugated systems that facilitate fluorescence. Key methods include condensation reactions, cyclization processes, and the incorporation of functional groups that enhance photostability and fluorescence intensity. Recent advancements have introduced bio-compatible and environmentally friendly synthesis routes, emphasizing the importance of green chemistry. Fluorescent dyes have widespread applications, ranging from bioimaging and medical diagnostics to materials science and environmental monitoring. The ongoing research aims to improve their spectral properties, stability, and specificity to target molecules, thereby expanding their utility in complex biological and industrial systems.
Prisha Maru	Photo assisted diamine coupling reaction of aldehydes	Iti Gupta	Chemistry	Photoredox catalysis provides a green alternative to organic transformations and is an

	catalysed by porphyrins			energy efficient process. Diamine coupling to form benzimidazole derivatives is an organic transformation that is traditionally carried out under high temperatures and harsh conditions. Benzimidazole derivatives have also been found to possess biological activities such as antiviral, antibacterial and anticancer. This report showcases an ecologically friendly pathway for the formation of benzimidazole derivatives under mild conditions. P1, P2 and P3 were previously synthesized in our research group. The catalytic activity of these three porphyrin catalysts were checked for the diamine coupling reaction. Model substrates were taken and solvent screening and catalyst screening was done for the reaction. Through a series of systematic investigations, we have shown the efficiency of P3 catalyst for diamine coupling reaction. This method utilizes a mere 0.25 mol% of the photocatalyst with a mixture of EtOH and $CHCl_3$ as solvents yielding high conversion to benzimidazole derivatives.
Priyanka Amrawat	Photocatalytic Organic Reactions With Gold Nanoparticles	Saumyakanti Khatua	Chemistry	This study investigated the synthesis and optimization of triangular gold nanoparticles (Au TNPs) for their photocatalytic properties, using acetonitrile as a solvent, Et3PAuCl as the gold precursor, trioctylamine (TOA) as a capping agent, and polymethylhydrosiloxane (PMHS) as a reducing agent. We synthesized Au TNPs, studied the effects of varying concentrations of TOA and PMHS, as well as reaction temperature, on the

				morphology and properties of the nanoparticles were examined through UV- visible spectroscopy and scanning electron microscopy (SEM). We found that smaller-sized TNPs, achieved under lower TOA concentration and higher PMHS concentration and with elevated reaction temperatures, it exhibited enhanced plasmonic effects, higher surface area-to-volume ratios, and more excellent stability. Characterization via SEM and UV-visible spectroscopy confirmed the formation of well-defined TNPs, with optimal reaction conditions yielding the sharpest and most defined triangular shapes. Additionally, in order to create an efficient photocatalytic substrate, the TNPs' surface was further functionalized with organic molecules such as para-substituted benzenethiols through Au-S chemistry and explored their efficiency in photocatalytic hydrogen evolution reaction. Apart from that we also modified and optimize the TNP surface with TEMPO using EDC/NHS coupling. The TNP surface functionalization with organic molecules were confirmed and optimized through UV-vis and SERS analysis. Some photoelectron catalysis studies were performed on these prepared photocatalytic substrates for HMF oxidation under neutral and basic condition. Here, TNPs are used as photocatalysts, which allowed us to harness renewable solar energy, with their photoexcitation generating hot carriers that drive chemical reactions. Our results indicate that integrating innovative catalytic materials like TNPs

				with renewable energy sources can significantly improve the kinetics and organic transformations, contributing to more sustainable and efficient catalytic processes.
Purva Kaushalbhai Shah	Nanoengineered Surfaces for Fouling/Antifouling Properties	Soumyadip Sett	Mechanical Engineering	This research report focuses on the study of nanoengineered surfaces for fouling and antifouling properties. Experiments were conducted on bare copper and copper coated with different nanosheets, such as HTMS, Fullerene, TiB_2, CuO, CuO + HTMS, and LIS. The investigation involved exposing these materials to $CaSO_4$ solution at a fixed concentration of 1g/L and temperatures of 70-75°C to observe the fouling behavior.
Rabari Jay Dineshbhai	Prediction of intermediate etching/deposition profiles using RNN/PINN/GPR	Nihar Ranjan Mohapatra	Electrical Engineering	In the semiconductor industry, precision etching at the nano-scale is critical for the development of next-generation electronic devices. This research focuses on developing a predictive model to accurately forecast intermediate etching and deposition profiles. By exploring advanced machine learning and deep learning techniques, we aim to enhance the prediction and optimization of these processes. The primary goal is to create a model that not only predicts profiles with high accuracy but also optimizes process recipes to achieve desired outcomes. Initial results indicate the potential for significant improvements in efficiency and reliability in semiconductor fabrication.
Rahul Kumar Singh	Development of an approach for mineral tonnage estimation using physical characteristics of	Vikrant Jain	Earth Science	Accurately calculating the tonnage of minerals is essential for various applications, including the imposition of penalties for illegal mining. This process

	minerals at different grain sizes.			requires the determination of three key physical parameters: grade, volume, and bulk density (BD) or specific gravity (SG). Prior studies suggest BD is preferable over SG due to the ambiguity of reference fluid's specific gravity, solubility effects, and inconsistent results from fluids with higher surface tension. The primary aim of this study is to establish the most accurate physical factor between specific gravity and bulk density for tonnage estimation and to derive a conversion factor for in-situ and stock mineral samples. Additionally, the study examines the impact of degradation and weathering on porosity, volume, density, and ultimately, the tonnage of earth materials. We conducted a comprehensive analysis of the available data on specific gravity and bulk density, focusing on their reliability and accuracy in different conditions. The study involved both theoretical assessments and practical experiments to derive a conversion factor. Our findings confirm that bulk density provides a more consistent and reliable measure for tonnage estimation compared to specific gravity. The derived conversion factor accounts for variations in mineral properties and environmental conditions, ensuring accurate tonnage calculations. This study emphasizes the importance of using bulk density over specific gravity for tonnage estimation in mineral assessments. The established conversion factor will aid in precise calculations of mineral content, essential for regulatory and economic

				evaluations. Further research is recommended to explore the long-term effects of environmental factors on mineral properties and their implications on tonnage estimations.
Rahulkumar Jitendra Panchal	Development of a Portable Water Purification System with Advanced Adsorbents and 3D-printed Cartridge	Biswajit Saha	All Departments	This project aims to develop a water filtration system using advanced adsorbents such as activated carbon and synthesized nanomaterials like reduced graphene oxide (GO) coated on polyurethane foam. The filter leverages air pressure for water purification using a normal cycle pump. Key equipment for prototype manufacturing includes the Creality K1 Max 3D Printer, which enables precise fabrication of intricate filter components, and software tools such as Autodesk Inventor, Autodesk Fusion 360, and Creality Print for design and optimization. The design process involves creating detailed models of the filter components in Autodesk Inventor, followed by refinement and animation in Autodesk Fusion 360. The finalized models are then sliced in Creality Print and fabricated using the Creality K1 Max 3D Printer. The resulting 3D-printed components form a new cartridge compatible with commercial activated carbon or custom adsorbents, with engineered threading to withstand high air pressure. A Dunlop valve facilitates the introduction of pressurized air, propelling water through the cartridge and adsorbent materials. Experimental tests using muddy water demonstrate the system's effectiveness in

				enhancing water clarity and quality. The project showcases the potential of 3D printing technology and advanced design software in creating customizable and efficient water purification systems, highlighting significant advancements in water treatment technology.
Raj Samnani	Investigating the ReaxFF molecular dynamics (MD) simulations of the solid-electrolyte interphase (SEI) in lithium-ion (Li-ion) batteries.	Raghavan Ranganathan	Materials Engineering	This report details the comprehensive research carried out during my summer research internship at the Indian Institute of Technology Gandhinagar (IITGN). The primary focus was on investigating the ReaxFF molecular dynamics (MD) simulations of the solid-electrolyte interphase (SEI) in lithium-ion (Li-ion) batteries. The study aimed to explore the effects of different ratios of lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) as the solid-electrolyte and tetraglyme as the organic solvent, with a lithium (Li) anode. Various temperature parameters were also considered to observe their influence on the formation of different products at the interphase.
Rajdeep Konar	Droplet Impact on Heated Super Hydrophobic Surface	Soumyadip Sett	Mechanical Engineering	High – performance electronic components generate a massive amount of heat per unit of area. It is possible that superhydrophobic coatings will be used in the future as a physical barrier between electronic components and water during cooling. This work presents a study of a droplet impacting an inclined super hydrophobic surface. The influence of surface inclination, surface wettability, Weber Number and surface temperature on the dynamic of spreading and

				receding is elucidated. Intriguingly, the contact time is independent of the surface temperature. This study provides a qualitative relationship to calculate the contact time of a droplet impacting an inclined hydrophobic surface, which can simultaneously efficiently evaluate the anti-freezing, anti-icing, and self-cleaning performance of hydrophobic surfaces employed in practical applications
Raveena. R	Chemical crystallography for small molecules	Vijay Thiruvenkatam	Biological Engineering	X-ray crystallography has been considered as the most reliable technique for determining the three dimensional atomic and molecular arrangement for small molecules. X-ray structures provide a scaled 3D representation of atom frameworks with respective configuration and spatial association. Small molecules are composed of tiny organic molecules which undergo structural investigation under diffraction methods like SCXRD, thereby providing the availability of suitable high-quality crystals. Antibiotic-based treatments currently have high failure rates due to resistance development by Helicobacter pylori (Hp) strains. Therefore, there is a growing demand for the discovery of novel targets to address H. pylori infection, wherein Hp IMPDH has been validated as a potential drug target. Hence, the present study reports the structural investigation of in -house small molecules developed as H. pylori IMPDH inhibitors using SCXRD.

Ravi Inderpreet Singh	Quantum Thermodynamics: Theory and Implementation of Quantum Heat Engines	B. Prasanna Venkatesh	Physics	This project aims to implement a two-stroke quantum heat engine, as proposed by M. S. Alam and B. P. Venkatesh in [1], on the IBM Quantum platform. This engine replaces one heat bath with a non-selective quantum measurement, influencing the engine's invariant reference state and work output predictions. The project extends previous work on quantum heat engines and quantum thermodynamics processes. Objectives: 1. To understand the fundamental concepts of quantum thermodynamics and the principles of quantum heat engines. 2. To reproduce existing results of two-stroke quantum heat engines using the Qiskit emulator. 3. To develop and implement the algorithm for the two-stroke measurement-based quantum heat engine on the IBM Quantum platform. [1] M. S. Alam and B. P. Venkatesh. Two-stroke quantum measurement heat engine. (arXiv:2201.06303), 2022
Rhishav Pandey	Bilingualism in Nepali News Media: An Analysis of English Word Integration	Jooyoung Kim	HSS	This work explores the influence of English on Nepali journalism by examining the use of English origin loanwords in Nepali news articles. After analyzing a dataset of 10,000 articles from ten different genres using Python tools, unique words were identified. 514 high frequency words (used over 50 times) were examined to understand genre distribution and semantic meaning of those words. It could be observed that the use of

				English-origin words in news articles were created and adopted for technology-related terminology. The diversified patterns show that a number of English-origin words emerge for various purposes. It potrays impact of globalization on Nepali language and also the domestic strategy of neologism, showing how Nepali journalism adopts new English-origin words to address emerging concepts.
Rishiraj Krishan	Development of 5-Degrees-of-Freedom Serial Manipulator Arm Integrated with Gripper	Vineet Vashista	Mechanical Engineering	This research project aims at the development of a Serial Manipulator Arm which exhibits 5 Degrees-of-Freedom, and which is also enhanced with a versatile gripper, to showcase robot manipulation capabilities. The main objective of this project is to engineer an efficient and cost-effective robotic arm that can be programmed to effectively carry out a variety of tasks, by integrating sophisticated motors with innovative design concepts. Hence implementing concepts of robotics engineering as well as contributing towards research advancements in the field of robotics and automation. The project aims to create a versatile robotic arm for applications in human assistance, automation, medical fields, and manufacturing industries. Key aspects of the development process are mechanical design, control system implementation, and performance testing. The project required the use of technologies such as Fusion-360 for design, Robot Operating System (ROS) for control, and Dynamixel motors

				for precise actuation. Final results of this project demonstrate the arm's capability to perform tasks with high precision and efficiency, paving the way for future enhancements and applications in various fields.
Rithvik Mandya Ammangatambu	Augmented reality and Virtual reality for molecular	Kaustubh Rane	Chemical Engineering	In the realm of molecular dynamics, predicting and visualizing the fluctuation of interaction energies within anisotropic molecules and their assemblies is a pivotal yet challenging task. These oscillations, which are frequently impacted by the complex dance of molecule orientations, are crucial for understanding phenomena like self-assembly, which are essential processes in material science and catalyst design. This project aims to bridge the gap between theoretical understanding and practical application by harnessing the immersive capabilities of Augmented Reality (AR) and Virtual Reality (VR) environments. By dynamically altering molecular orientations and observing the corresponding changes in interaction energies in real-time, researchers and practitioners will gain unprecedented insights into the self-assembly potential of molecules. These discoveries could revolutionize the design of catalysts, aid in the creation of new materials, and progress a number of industrial applications where exact control over molecular interactions is critical. With the help of this project, we hope to equip engineers and scientists with an effective tool for investigating and learning about the intriguing field of molecular dynamics, spurring breakthroughs in a variety of

				fields and stimulating creativity.
Riya Kundu	Optimization of parameters for extrusion-based 3D printing	Karthik Subramaniam Pushpavanam	Chemical Engineering	This experiment investigated the mechanical characteristics of sodium alginate beads utilized in 3D printing applications. The study specifically sought to understand the special shape preservation and potential distortion of these beads by observing their behavior under various parameters The 3D printing of biopolymers, such as sodium alginate, has gained significant attention due to its inherent biocompatibility and its ability to form hydrogels through ionic crosslinking.. The results of this experiment can help improve 3D printing procedures using hydrogel materials, such as sodium alginate. Alginate-based materials are essential for producing alginate-based materials that may find use in biomedicine. This study aimed to improve the process of 3D printing sodium alginate and divalent solutions, which are essential for producing alginate-based materials that may find use in biomedicine. To achieve efficient crosslinking and printing, the study focused on adjusting the flow rate, needle distance, extrusion speed, and the interaction between alginate and divalent solution. A heated container to keep the agar solution liquid was also investigated to improve printability. The results highlighted the need for careful parameter optimization to obtain the appropriate material properties and print quality….
Riya Raisinghani	How are jumping genes controlled?	Sharmistha Majumdar	Biological Engineering	Transposable elements (TEs) are significant contributors to genetic diversity and

				regulatory complexity in the human genome. Among these, the THAP9 gene, a homolog of the Drosophila P-element transposase, has emerged as a candidate influencing various biological processes. This study investigates the regulation and expression of THAP9 across various conditions using RNA-Seq data. Differential gene expression (DGE) and co-expression network analyses were conducted to explore THAP9's regulatory roles and expression patterns. This comprehensive analysis highlights the importance of THAP9 and other co-expressed genes in understanding the complex regulatory networks in human health and disease, particularly in the context of neurodegeneration and cellular differentiation.
Rohit Gupta	Large Hadron Collider Analysis of BSM Physics using Machine Learning	Baradhwaj Coleppa	Physics	The Two Higgs Doublet Model (2HDM) extends the Standard Model of particle physics by introducing an additional Higgs doublet that offers an explanation for phenomena such as electroweak symmetry breaking, CP breaking, and the existence of dark matter. The complexity and huge parameter space of 2HDM pose significant challenges to traditional analytical approaches. This project uses machine learning techniques to explore and constrain the 2HDM parameter space. By generating large datasets and using a neural network in combination with XGBoost, the goal is to identify physically viable parameter regions consistent with experimental data and theoretical constraints.

				Initially, the model's performance was hindered by an unbalanced dataset, resulting in low accuracy. To address this, we emphasize the importance of balanced datasets and propose additional tuning and advanced algorithms to improve model robustness. However, after balancing the dataset and retraining the model, significant improvements in both precision and accuracy were achieved. Visualizations, including corner plots, are used to clarify relationships within the 2HDM parameter space. This interdisciplinary approach not only improves our understanding of 2HDM, but also paves the way for more efficient exploration and potential experimental verification of new physical phenomena.
Roshan Savio A	Influence of non-thermal active fluctuations over colloidal dynamics under crowded conditions	Krishna Kanti Dey	Physics	Understanding the dynamics of colloidal particles in crowded environments in the presence of active fluctuations is crucial for getting insights into various biochemical processes. The study aims to investigate the nature of colloidal dynamics in such environments that mimic intracellular conditions. Optical microscopy is used to track the motion of the colloidal particles to get the images at different time frames. These images are then analyzed using different software modules in Python to calculate the diffusion coefficients and hence the dynamics of the colloidal particles. The study is motivated by previous findings that show enhanced diffusion of enzyme molecules during

				the catalysis activity, influence on the passive tracers in the vicinity of activity, etc. An extensive literature survey is done to understand the state-of-the-art of the field and identify questions that are yet to be answered using experiments. Different techniques are employed to calculate the diffusive dynamics of particles from the raw data acquired from microscopic images. Further, the results of the study aim to provide insights into how non-thermal active fluctuations influence the dynamics of colloidal particles in their vicinity and understand the fundamental mechanisms behind them.
Rugved Milind Upaddhye	Serial Manipulator Arm	Vineet Vashista	Mechanical Engineering	This report details the 8-week progress in developing a 5 degree of freedom (DOF) Serial Manipulator Arm with a gripper. The project aims to create a versatile robotic arm for applications in human assistance, automation, medical fields, and manufacturing industries. Key aspects of the development process, including mechanical design, control system implementation, and performance testing, are discussed. The report highlights the use of advanced technologies such as Fusion-360 for design, Robot Operating System (ROS) for control, and Dynamixel motors for precise actuation. Results demonstrate the arm's capability to perform tasks with high precision and efficiency, paving the way for future enhancements and applications in various fields.
Sajay Raj	Air Quality Forecasting With LLMs/Transformers	Nipun Batra	Computer Science	Our research investigated the potential of Large Language Models (LLMs) in air quality forecasting, a critical

				environmental science domain. We explored approaches to utilize LLMs' pattern recognition capabilities for what we expected would result in accurate and efficient air quality predictions. Our study began by examining simple prompting methods-Zero and Few shot included, and moved up to prompting techniques introduced by the LLMTime paper, which showed improvements in older models but limited impact on advanced LLMs. We then moved to attempt to use the TimeLLM architecture, which was a model architecture which was built to utilize LLM's large knowledge base and pattern prediction capabilities for time series tasks, but quickly found unexpected results where removing the LLM component improved performance, suggesting LLMs functioned more as predictable noise generators in this context. Our findings led us to question the fundamental utility of LLMs in time series forecasting. Pivoting our focus, we evaluated Time Series Foundation Models, specifically Amazon's Chronos and Google's TimeFM. TimeFM demonstrated remarkable zero-shot performance, outperforming previous Transformer-based and LLM-based models. This success highlighted the potential of Large Time Series Models (LTMs) pre-trained on diverse time series data. Based on these results, we propose future research directions, including methods to incorporate multivariate input in TimeFM models and exploration of novel architectures like state-space

				models and xLSTM. This study contributes valuable insights to the evolving field of time series forecasting, particularly in environmental applications, and sets the stage for more efficient and accurate air quality prediction models.
Sakshi Anand	Prototyping of Pneumatic Hand Glove for Finger Joint Rehabilitation		Maker Bhavan	This project report details the design and fabrication of a soft pneumatic finger actuator for rehabilitation equipment, aiding in the recovery of hand function post-injury or stroke. The actuator, made from silicone rubber (Mold Star – 15), features multiple air chambers and is created via a casting process. Using CAD software and 3D printing, we designed and prototyped the actuators, which mimic human finger movement. These actuators were mounted on a glove, forming a lightweight, comfortable, and easy-to-operate rehabilitation device. By controlling air pressure, we adjusted the force and bending angle. The glove successfully grasped and held small objects, demonstrating its potential for practical rehabilitation use.
Sania Rawat	Existence, uniqueness and qualitative theorems in ODEs	Jagmohan Tyagi	Mathematics	This report explores key aspects of the existence and uniqueness of solutions to ordinary differential equations with certain initial conditions that help understand their analytic behaviour. It begins with Peano's theorem, showing local existence of an initial value problem when certain conditions are fullfilled. Then, we state a Global existence theroem that specifies the conditions required for a solution to exist on the entire interval in question. Subsequently, we shift our interest towards uniqueness

				theorems to explore different criteria, starting with Picard's theorem that implies uniqueness of a local solution when Lipschitz continuity with respect to the dependent variable is fullfilled. Following that, another theorem is discussed that guarantees uniqueness when Osgood's criterion is fulfilled, that is a more encompassing one than the previously discussed Lipschitz criterion. We then proceed to another generalisation of Osgood criteria, given by Montel and Tonelli. Ultimately, Nagumo's theorem is presented that also provides an alternative way to check for uniqueness of solutions for an IVP, along with an example of a function following the Nagumo criterion. The report concludes by introducing a recent research paper by A. Constantin about a convex combination of Nagumo and Osgood criteria also implying uniqueness of solutions of ODEs.
Sanjana	Expression and Purification of Amyloid β 42 (Aβ-42)	Sharad Gupta	Biological Engineering	Alzheimer’s is a progressive neurodegenerative disease and the most common cause for dementia. It results in memory loss, personality and cognitive decline. The hallmarks of Alzheimer’s are extracellular accumulation of amyloid β (Aβ) into plaques and the intracellular deposition of hyperphosphorylated Tau protein in neurofibrillary tangles. These aggregates also lead to neuroinflammation and subsequent damage to neurons, which may result in neuronal death. Aβ results from the amyloidogenic processing of Amyloid Precursor Protein (APP), where APP is first cut by β-

				secretase followed by further cleavage by γ-secretase to release Aβ peptide into extracellular space that ultimately leads to amyloid formation and plaques. The Aβ-40 and Aβ-42 are the two major forms of Aβ. It has been reported that Aβ-42 has greater propensity to aggregate than Aβ-40. Post translational modifications (PTMs) also seem to increase the aggregate propensity of Aβ 42. In our study we express and purify Aβ 42 in E. coli.
Sanjith Cumarasurier	Effect of varying pH on the dehydrogenation of formic acid over a palladium catalyst mounted on titanate	Abinaya Sampath	Chemical Engineering	Hydrogen has been found and proven to be an alternative renewable energy source that is readily available with a high energy density. The reason behind its delayed implementation lies in issues associated with its storage, production and transport. Formic acid dehydrogenation was identified as the most suitable for the methods identified as economically viable for hydrogen production due to its high efficiency, low toxicity and flammability, among other reasons. Optimising the dehydrogenation process of formic acid can prove to be immensely useful in the process and, thus, the future economy in terms of energy production. In our process, we will be using palladium along with titanate(TiO_2) as a catalyst in this dehydrogenation reaction. Our goal is to produce hydrogen from formic acid in an economically viable method, which requires determining the most suitable reaction conditions to promote hydrogen formation, such as pH conditions.
Sanvi Shukla	AI-Driven Hint Text Generation for	Yogesh K Meena	Computer Science	Mobile applications have become necessary tools in

	Improved Mobile App Accessibility			modern life, performing various purposes ranging from communication and entertainment to shopping and finance. As the use of mobile applications continues to increase, it is essential to prioritize improving user experience and ensuring accessibility. One often overlooked but critical aspect of user experience is the inclusion of hint texts for input fields. According to a study referenced in this paper, an analysis of 4,501 Android applications with text input fields revealed that over 76% of applications lack hint texts. This omission poses significant challenges for individuals with vision impairments who rely on screen readers and other assistive technologies to navigate digital interfaces. The absence of hint texts can lead to confusion and hinder the overall usability of the application for these users. To address this issue, we developed a Transformer-based language model designed to generate appropriate hint texts by analyzing the graphical user interface (GUI) information associated with each input field. Our approach leverages Reinforcement Learning to iteratively improve hint text generation, learning from previous mistakes to provide better hints over time. This solution not only enhances the accessibility of mobile applications but also contributes to a more inclusive digital environment for all users.
Saurabh Kumar	Application Development for Library IITGN	Kumbar T S	Library	The IITGN Library application development project is a comprehensive initiative to

				enhance the accessibility and usability of library resources for the IIT Gandhinagar community. The application, designed using the Flutter framework, offers a wide range of features to cater to the needs of students, faculty, and staff. This report outlines the development process, features, and impact of the application, developed under the guidance of Dr. Kumbar, a Librarian whose valuable feedback was instrumental at every stage of development.
Shaurykumar Patel	POC/Prototyping of Pneumatic Hand Glove for Finger Joint Rehabilitation		Maker Bhavan	PneuNets actuators, a type of soft pneumatic actuator, has the ability to mimic natural movements. Their design often involves interconnected air chambers that inflate and deform to generate motion. This research focuses on the development of a soft robotic glove utilizing PneuNets actuators for finger joint rehabilitation. The goal is to create a device that can assist individuals in regaining hand function after injury or stroke, offering a safe and effective alternative to traditional rehabilitation methods.
Shikalgar Shahid Jahangir	Development of an approach for mineral tonnage estimation using physical characteristics of minerals at different grain sizes	Vikrant Jain	Earth Science	This report focuses on developing an approach for mineral tonnage estimation using physical characteristics of minerals at different grain sizes. Accurate estimation of mineral resources and ore reserves is crucial for effective resource management and economic planning. This study addresses the key parameters needed for tonnage calculation: grade, volume, and bulk density (BD) or specific gravity (SG), and emphasizes the impact of porosity on these values. Fieldwork was conducted in

				various districts of Gujarat to collect a wide range of mineral samples, including basalt, clays, sand, bauxite, laterite, and fireclay. Laboratory analyses were performed to measure bulk density, grain density, and porosity. Special attention was given to the effects of porosity on BD/SG values, as porosity varies with grain size and significantly impacts the accuracy of tonnage estimations. The results highlight the importance of considering porosity when calculating mineral tonnage. A conversion factor (CF), representing the in-situ density of the material, was determined for each mineral type. The final tonnage can be calculated by multiplying the CF by the total volume of the mineral deposit. The study concludes with a proposed methodology for consistent mineral tonnage estimation that incorporates the effects of porosity on BD/SG. This approach ensures more accurate resource estimation, which is essential for mining operations and economic planning. The report also includes a tonnage calculator, developed to facilitate the application of this methodology in practical scenarios. The findings contribute to a more reliable and standardized approach for mineral resource assessment, addressing the challenges posed by grain size variations and porosity.
Shiva Singh Bagri	ML for sustainability	Nipun Batra	Computer Science	Brick kilns are a major part of air pollution that causes the deaths of thousands every year. The labeled dataset is not commonly available. Training for every geography is not feasible due to manual

				labeling and compute cost. Hence, the aim here is to adapt brick kiln detection models trained in one geographic region to use in diverse geographic regions by domain adaptation
Shivani Saraswat	Exploration of MS-PCET using Ferrocene-based Mediator for the Electrochemical Organic C-H Bond Activation and N-N Bond Formation.	Biswajit Mondal	Chemistry	MS-PCET provides precise control over redox potentials and pKa, allowing for meticulous adjustment of reaction pathways and selectivity while providing kinetic advantage in catalysis. Introducing a pendant brønsted-base moiety in an electron-transfer system brings the MS-PCET mechanism within the same molecule. Inspired by this, we designed a pyridine-appended Ferrocene-based mediator for the electrochemical C-H bond oxidation. The BDFE of the mediator was calculated as 78.8 kcal mol-1 using the redox potential and pKa values. The substrates were chosen in such a way that their BDFE should be less than that of the mediator. Hence, our study focused on the benzylic C-H bond activation of Tetrahydroisoquinoline (THIQ) and Hantzsch ester (HE). Along with this, we explored the aerobic oxidation of Hydrazobenzene to study the reaction kinetics. In the other part, we focused on the electrochemical N-N bond formation from Ammonia and Hydrazine using Fc-based mediators.
Shivrajsinh Sandip Bhosale	Developing Nanoengineered Surfaces for Thermal Management Applications	Soumyadip Sett	Mechanical Engineering	This research investigates the heat transfer properties of TiB_2-coated nano-sheets on copper substrates. The study evaluates their potential as efficient heat spreaders and explores their antifouling characteristics. A series of experiments were

				conducted, including heat spreading tests, single drop evaporation assessments, drop area analysis, multiple drop tests, and antifouling tests on bare copper. The performance of TiB_2-coated nano-sheets on copper was compared with that of bare copper.
Shounak Naskar	Development of Novel ATR kinase inhibitor	SivaPriya Kirubakaran	Chemistry	Cancer remains a significant cause of death despite declining mortality rates. Chemotherapy, while effective in the short term, often fails to provide long-term cures due to cancer cell's ability to repair damaged DNA. In DNA Damage Response (DDR) pathway, particularly the ATR protein, plays a crucial role in this repair mechanism. Cancer cells are heavily dependent on this mechanism for proliferation. Hence, inhibiting the activity of ATR can provide us viable leverage over our battle against cancer. However, current ATR inhibitors like caffeine and wortmannin have limitations including toxicity and decreased solubility. This study aims to combine known ATR inhibitors to create a more effective and selective compound, leveraging successes like AZD 6738, VX 970, M 1774 BAY 1895344, and Torin 2. The goal is to develop a novel ATR inhibitor that can improve cancer treatment outcomes by disrupting the DDR pathway and enhancing the efficacy of current therapies.

Shrey Patel	Augmented reality and Virtual reality for molecular modeling	Kaustubh Rane	Chemical Engineering	The comprehension and depiction of chemical molecule structures constitute a significant aspect of chemistry and related sciences. Conventional molecular structure analysis methods may not be able to fully capture complex spatial relationships and dynamic behaviors. Static 3D models and 2D schematics are two examples of these methods. The way people interact with molecular structures can be significantly enhanced by the immersive, interactive settings made possible by augmented reality (AR) and virtual reality (VR) technologies. In addition to giving users a simple and enjoyable way to view molecular structures, the aim of this project is to build an AR/VR application that can predict the stability of newly created particles. Through the provision of an interactive molecular stability exploration platform and real-time feedback, this technology seeks to transform the educational experience for both researchers and students.
Shreyas Kumar	Generalization of Skill Learning via Iterative Learning Control at Grasp Level	Harish P M	Mechanical Engineering	In dynamic robotic applications, the ability to swiftly adapt to diverse tasks is essential for operational efficiency. Traditional methods, such as Reinforcement Learning (RL), often require extensive relearning, limiting practicality. This research presents a novel approach leveraging Iterative Learning Control (ILC) to enhance robotic adaptability, focusing specifically on grasping tasks. Initially learning fundamental grasping skills, the robot refines these skills through iterative adjustments,

				enabling rapid adaptation across varied tasks. Experimental validation demonstrates the efficacy of ILC in minimizing errors during learning phases and achieving nearly error-free performance with minimal iterations for new tasks. Key components integrated include compliant fingertips for stable contact, an adaptive nullspace controller for maintaining grasp stability, object impedance control for dynamic interaction management, and sensor fusion using EKF to mitigate perception delays. Overall, this research introduces a robust method to significantly improve the adaptability and efficiency of robotic systems in dynamic environments. Future directions include refining control algorithms and expanding the method's applicability to broader generalization scenarios.
Shrinivas Jagdish Kulkarni	Benchmarking the environmental performance of buildings in India using LCA	Sameer Patel	Civil Engineering	The project is to benchmark the performance of Indian buildings using the life cycle assessment process to make them more sustainable.
Shruti Dubey	Discovery Potential In Three Higgs Doublet Model	Baradhwaj Coleppa	Physics	This study explores the discovery potential of the Three-Higgs-Doublet Model (3HDM) in particle physics, focusing on collider phenomenology and implications for beyond the Standard Model (BSM) physics. Using MadGraph5 aMC@NLO, cross-sectional data was generated to simulate signal and background processes. We investigate the pp → Ah2 → h2 Z → b b bar → l+l− process as a signature of additional Higgs bosons Ah2 and h2, including the pp → b bar → l+l− as a chosen

				background of Standard Model. Counting experiment technique, utilizing upROOT methods, was employed to calculate event yields. Further enabled statistical analyses, including likelihood ratio tests, test statistics, and partial cell sum techniques for histogram binning. These analyses aimed to assess the significance of signal detection and establish confidence levels for signal exclusion of 3 Higgs Doublet Model processes involving both electroweak and strong interactions.
Shylesh P K	Modelling, Control and Optimization of complex process systems	Hari Ganesh	Chemical Engineering	This project aims to employ controllers ranging from conventional P controllers to an advanced MPC controller to control complex chemical process systems like reactor with a cooling jacket, thermal mixing process, interacting tanks, reactors in series, distillation columns, and reactor separator recycle and analyze their performance using various performance comparison parameters like overshoot, decay ratio, peak deviation, sum of squared errors etc. The script language and Simulink from MATLAB will be primarily used in this project. The first part of the work will be on developing conventional feedback controllers by deriving transfer function-based models using the first principle models of the system considered in the study. Further, tuning of P, PI, and PID controllers is highly important and plays a key role in obtaining efficient controller performance. In this work, tuning is to be done via an in-build function in MATLAB called “PidTune”, ZN method, Tyrus method, and FODPT.

				The later part of the project will focus on developing transfer function-free digital PID controllers as well as advanced controllers such as MPC. Initially the controllers are implemented from case studies such as thermal mixing process and continuous stirred tank reactors and with the results it will be proceeded for real time applications.
Siddharth Singh	Development of IoT-enabled low-cost particular matter sensor	Sameer Patel	Civil Engineering	The project "Development of IoT-enabled Low-Cost Particulate Matter Sensor" aims to design and implement an affordable and efficient system for monitoring air quality using the PMS5003 sensor. This sensor measures particulate matter (PM1.0, PM2.5, and PM10) concentrations. The project integrates the PMS5003 with microcontrollers such as Arduino Uno and NodeMCU ESP8266, enabling real-time data collection and transmission. Data is published to AWS IoT Core, processed using AWS Lambda, and stored in an AWS S3 bucket in CSV format. Additionally, a MicroSD card module ensures local data logging for redundancy. Key milestones include successful sensor interfacing, cloud integration, and the development of a robust visualization dashboard. The project addresses challenges in data display and server communication through meticulous testing and optimization. The final system offers a reliable, scalable solution for air quality monitoring, with future enhancements planned to improve data interpretation and user interface. This

				project demonstrates the potential of IoT technologies in creating cost effective environmental monitoring solutions.
Smita Chatterjee	Developing a report on IITGN Campus Biodiversity	Chhavi Nath Pandey	Earth Science	Biodiversity conservation helps protect essential ecological processes and maintain the health of ecosystems. Here, we examine the challenges as well as potential opportunities to consider the current state of biodiversity within the campus premises of the Indian institute of Technology Gandhinagar (IIT GN). The IITGN campus located at Gandhinagar, Gujarat is a perfect micro-sample of the local ecosystem; however, the biodiversity of the campus is under threat by rapid development and urbanization. This study also examines the state of animals and plants in this complex. The campus of IITGN, designed with eco-friendly considerations provides a great opportunity to demonstrate and learn about the conservation of biodiversity within an enclosed space. This research should provide important information for devising appropriate conservation strategies by mapping the present population of plants and animals. The overall aim of this research is to design a model addressing sustainable conservation biodiversity within the campus.
Sree Samhita Gundimeda	Electromagnetic Levitation Platform	Manish Jain	Creative Learning	This research was based on electromagnetic levitation. Where we looked into the process of electromagnetism in depth, and took those properties and applied them in our project. The simple idea is to use the laws of attraction and repulsion in magnets. In

				addition to that it was to use the variable magnetic strength, and the polarity changes in the electromagnets to levitate another piece of magnet (the platform)
Sreyan Goswami	Development of a Portable Universal Testing Machine(UTM)	Manish Kumar	Civil Engineering	The report covers the grounds for what, how, and why a Universal Testing Machine is used, an alternative to the generic Universal Testing Machine (UTM) designs, and how it can be built. The primary objective of this project is to design a portable UTM that can withstand a load of 1kN. The central focus is on compressive loading on test specimens. However, the set-up can be conveniently used for tensile testing as well if an appropriate jaw is used. The report presents the details of the parts required to build the UTM. The Arduino code to control the UTM, the electronic circuit, and the electronic components are also discussed in detail. The machine should weigh approximately 30 kg. The parts are designed so that they can be upgraded in the future. A few parts are detachable, making the UTM flexible. The report is expected to facilitate the fabrication of the UTM.
Srivathsa Vamsi Chaturvedula	Implementing Generative Models in CV and Image Impainting task uding LDM	Shanmuganathan Raman	Computer Science	Understanding and implementing Variational Autoencoders (VAEs), Vector-Quantized VAEs, Generative Adversarial Networks (GANs), and Latetnt Diffusion Probabilistic Methods
Sumedh	Improved Edge Coloring Algorithms	Manoj Gupta	Computer Science	Consider an undirected simple graph G = (V, E). Our aim is to color the edges of this graph of this graph such that no two adjacent edges have the same color. In this report we study a near linear time static algorithm which uses more

				than ∆ + 1 having some slack (there are more colors free on the vertices than just one) on each of the vertices and coloring the edges in O˜ (m/ε2).
Sunny Kumar Rajak	Synthesis of fluorescent dye intermediates	Sriram Kanvah Gundimeda	Chemistry	Fluorophore (fluorescent dye intermediate) is a useful tool that helps visualize the cell organelles (mitochondria, plasma membrane, endoplasmic reticulum, ribosome, etc.). The fluorophores provide proper visualization of the fluorescent behaviour of cell organelles by which we can understand the workings and properties of cell organelles. These functions of fluorescence help to understand disease mechanisms and development of new therapeutic strategies. In our study, we designed different types of fluorophores, which help to find the sub-cellular localization. We also aimed to synthesize cationic pyridinium fluorophores, which help to localize the mitochondria membrane due to the negative charge on the membrane. These fluorophores give chemical tunability, higher sensitivity, and wash-free imaging, making them valuable tools for imaging mitochondria and studying their cellular process.
Suraj Buddhadev Ghosh	Fabrication of ZnO Varistors	Sriharitha Rowthu	Materials Science & Engineering	The project aims to develop and understand the complete fabrication process of ZnO varistor, for electrical surge protection. The process starts with cold compaction through silver plating on the sintered body and then electrode soldering and finally insulator coating. The fabrication process plays an important role in the development of the micro-structure which in

				turn affects the electrical properties of the varistor.
Susmita R	Investigation of usage of bio-based additives in concrete	K. Siva Teja Chopperla	Civil Engineering	Global warming, climate change, agricultural waste management are some of the critical problems that demand solutions for a sustainable future. This study involves investigating the usage of two types of biochar, sugarcane bagasse and rice husk, in concrete and studying their mortar properties. Determining optimum dosage of biochar in the mortar and the resulting CO_2 eq. emission reduction by Life cycle Assessment is the main objective of the study.
Tamizhanban A G	Position or Force Control for Robotic Manipulators: Closing Bottle Cap with OpenMANIPULATOR-X	Harish P M	Mechanical Engineering	Robotic manipulators are pivotal in various industrial and domestic applications. This study focuses on closing bottle caps using the OpenMANIPULATOR-X robotic arm. OpenMANIPULATOR-X is a manipulator made for educational purposes, and it is very compatible with ROS. Our objective is to explore force control or position control strategies to achieve precise manipulation. We delve into the configuration space of OpenMANIPULATOR-X, discussing joint angles and degrees of freedom. Forward kinematics equations are derived to determine end-effector positions, while inverse kinematics enables us to compute joint angles from desired positions. The ROS (Robot Operating System) framework facilitates control of OpenMANIPULATOR-X. We implement force and position control algorithms, leveraging computer vision (OpenCV) for cap position

				detection. Our experimental results reveal trends in end-effector force and position during cap closure. By analysing these trends, we infer the effectiveness of different control approaches. This research contributes to advancing manipulator capabilities, demonstrating the potential for robotic arms to handle intricate tasks beyond industrial settings.
Tammy Lalhmingthangi Ralte	Dynamic Polymer Simulation - Real-Time Molecular Interaction and Energy Visualization in AR	Kaustubh Rane	Chemical Engineering	This report details the development and outcomes of a research project focused on creating an interactive 3D polymer chain model using augmented reality (AR) to enhance visualization and interactivity. The objective is to simulate realistic polymer dynamics, enabling real-time observation of energy changes and structural alterations, thereby advancing educational and research tools in the field of molecular dynamics. The research aims to advance molecular dynamics by developing a 3D polymer chain model enhanced with AR. Traditional molecular graphics tools are limited to 2D views, reducing user engagement and spatial understanding. AR offers a solution by enabling intuitive manipulation of 3D objects, providing better self-awareness, reduced dizziness, and easy deployment on mobile devices.
Tanishka Gurjar	Urine Treatment: Nitrogen and Phosphorus Harvesting &	Bhaskar Datta	Biological Engineering	This study aimed to develop and optimize a dual-function method for treating human urine by eliminating bacterial

	Detoxification by Removal of Bacterial and Pathogens			pathogens and recovering essential nutrients such as phosphate and nitrogen. The approach combined urease-immobilized magnetic nanoparticles (MIONPs) with banana peel powder (BNPP) for effective urea hydrolysis and ammonia adsorption. MIONPs were synthesized and coated with chitosan, followed by urease immobilization using glutaraldehyde. BNPP was prepared from dried banana peels. Experimental results showed that urease-immobilized nanoconstructs significantly increased ammonia concentration in artificial urine, and subsequent BNPP addition effectively adsorbed ammonia. The system's performance was evaluated across various urine dilutions, demonstrating its scalability. This dual-function method offers a sustainable solution for nutrient recovery and safe disposal or reuse of treated urine, contributing to improved agricultural practices and waste management.
Tejas Dinesh Patil	Lego Technic Stem Projects	Manish Jain	Creative Learning	This report explores the educational potential of LEGO Technic sets, a line of construction toys that incorporate gears, motors, and batteries. By building complex, functional models, children engage with fundamental mechanical principles at an early age. The report details how LEGO Technic sets: • Introduce core mechanics: Gears, axles, and levers become tangible tools for understanding concepts like force, motion, and power transfer. • Spark curiosity: The

				interactive nature of the builds encourages problem-solving and experimentation, fostering a love of learning. • Bridge the gap to STEM: LEGO Technic sets provide a fun and accessible entry point to Science, Technology, Engineering, and Math (STEM) fields.
Tinodaishe Semwa	Fluorescence Sensing applications from Green Synthesized Carbon Nanoparticles	Jhuma Saha	Electrical Engineering	This research explores the green synthesis of carbon nanoparticles (CNPs) utilizing various plant extracts, with a particular focus on microwave synthesis techniques. Emphasizing environmentally benign methods, the study aims to contribute to the sustainable production of CNPs, which hold significant potential in bioimaging, drug delivery, environmental monitoring, energy harvesting, and specifically, metal ion sensing. The synthesis process employed leaves from Mangifera indica (mango), Syzygium cumini (Jamun) and Azadirachta indica (neem), selected for their rich phytochemical content and efficacy in nanoparticle synthesis. The use of microwave synthesis offers advantages such as reduced reaction times and energy efficiency. Characterization of the synthesized carbon dots was performed using techniques including Transmission Electron Microscopy (TEM) for structural analysis, UV- Vis spectroscopy for optical properties, and Photoluminescence (PL) spectroscopy for fluorescence behavior. This report details an extensive literature survey on green synthesis methods, the step-by-step synthesis process using microwave technology, characterization of

				the synthesized carbon dots, and an analysis of their application in metal ion sensing. The findings and future directions outlined in this study aim to enhance the understanding and practical application of green synthesized carbon nanoparticles in various technological and environmental fields.
Vaishavi Venkatesh	Designing a Tactile Stimuli System to Replicate Insect Crawling Sensations	Leslee Lazar	HSS	Tactile hallucinations — the false perception of tactile sensory input — cause distressing sensations of crawling, itching or tingling on the skin when no such stimulus exists. These hallucinations are present in individuals suffering from illnesses like schizophrenia and extreme drug abuse. The self-inflicted injuries from the hallucinations caused by these individuals cause major distress and poor quality of life. There is a notable gap in the literature regarding therapeutic interventions targeting these specific tactile sensations. This might be due to the predominance of auditory and visual hallucinations over tactile in patients having these neurological conditions. To address this gap, this research aims to understand tactile hallucinations, specifically crawling, by designing a tactile stimuli system capable of replicating these hallucinations on the skin. This understanding has the potential to create a therapeutic tool for sufferers to overcome their hallucinations.
Vaishnavi Umesh Banniko	Development of microscale chemistry experiments for stem education	Manish Jain	Center for Creative Learning	In the Indian education system, textbook-centric teaching often results in superficial understanding of

				subjects like chemistry, where abstract concepts are crucial. In most of the schools we have observed problems such as equipment & chemical constraints and lack of space, fear of exposing children to harmful chemicals, lack of practical exposure among teachers. School teachers training is also largely devoid of experiential learning as envisaged in NEP 2020. The microscale chemistry techniques introduced here will encourage experiential and engaging hands-on learning that fosters curiosity, enhances conceptual understanding and makes chemistry education more interesting. To solve the problem of space, cost, chemical disposal and waste, these microscale experiments designed by us would be a part of the chemistry kits which will impact over 5 lakh students in more than 5000 schools across India.
Vannsh Jani	ML for sustainability: Satellite Data Processing for Detecting Pollution Sources using Computer Vision	Nipun Batra	Computer Science	Air pollution kills 7 million people annually. The brick manufacturing industry is the second largest consumer of coal, contributing to 8%-14% of air pollution in the Indo-Gangetic plain (a highly populated region in India). Due to the unorganized nature of brick kilns, monitoring their growth on a large scale is challenging. Pollution control boards periodically conduct extensive field surveys to identify non-complying brick kilns, which is a highly time and resource-consuming process. Air quality experts digitally annotate brick kilns using tools such as Google Earth. Previous work has employed computer vision to detect brick kilns from satellite

				imagery but they do not leverage latest innovations in object detection such as methods with oriented bounding boxes. In this paper, we explore the state-of-the-art object detection models for brick kiln detection using multiple satellite imagery sources. We use the best model among all to build a hand-validated dataset of 23023 brick kilns from 5 states in the Indo-Gangetic plain covering the area of 520k km^2. We demonstrate domain applications such as automatic compliance monitoring and improving pollution inventory for air quality modeling. Our dataset has the potential to be a benchmark dataset for oriented object detection models.
Vasishtha Sandeep Pandya	Conversational User Interfaces and LLMs	Yogesh K Meena	Computer Science	In contemporary digital environments, traditional user interfaces often fall short in providing intuitive and natural interactions, leading to user frustration and decreased engagement. Conversational User Interfaces (CUIs) powered by artificial intelligence (AI) have emerged as a promising solution, enabling users to interact with digital systems using natural language. However, these interfaces face challenges such as understanding user intent, generating accurate responses, and maintaining coherent dialogues. This project aims to address these challenges by designing and implementing AI-driven CUIs that offer seamless and engaging interactions. The project employs advanced natural language processing techniques, Retrieval-Augmented Generation (RAG), and Large Language

				Model (LLM) APIs to enhance conversational AI capabilities.
Vedant Ojha	Fabrication and Analysis of Printed capacitor	Biswajit Saha	Chemical Engineering	Flexible capacitors represent a cutting-edge advancement, in energy storage technology challenging the conventions of designs. They show potential for use in electronics and on curved surfaces. Unlike fixed capacitors, these innovative devices utilize materials in their electrodes and substrates enabling them to be seamlessly integrated into clothing rolled up or stretched without sacrificing performance. The focus of this study is on developing and analysing a capacitor created through ink jet printing with the goal of exploring its applicability in commercial settings. To achieve this, different materials were evaluated for their electrode properties to determine their suitability, for ink jet printing. Following material selection, the capacitor's performance was planned to be rigorously assessed.
Venkata Sathya Pavani Tirunagari	Detection of Trojans using Reinforcement Learning	Joycee Mekie	Electrical Engineering	Detecting hardware Trojans is challenging due to the complexity of modern hardware. This research employs Proximal Policy Optimization (PPO), a cutting-edge reinforcement learning model, to enhance detection capabilities. By analyzing circuit nodes and identifying rare nets, we use rigorous statistical methods to assess pairwise compatibility. The PPO model efficiently identifies compatible rare nets, optimizing parameters for accuracy. Additionally, PySAT solvers optimize input patterns, generating compact sets with maximal trigger coverage. Our approach significantly improves detection accuracy and

				efficiency, advancing hardware security and demonstrating the potential of reinforcement learning in complex system analysis and cybersecurity.
Vivek Verma	Performance of Vermiculite and Polyamide membranes for Salt and Dye rejection application	Gopinadhan Kalon	Physics	Freshwater scarcity is one of the critical problems in the 21st century. The continuous growth of the economy and population requires a high demand for fresh water. As only 0.8 % of the total Earth's water is freshwater, Humanity has to develop better technologies which are sustainable and cost-effective to satisfy the increasing water consumption(1). Polyamide (PA) Thin flm composite (TFC)membranes are among the most used membranes in reverse osmosis (RO) water fltration processes. These ultrathin membranes can be synthesized by interfacial polymerization(IP). This interfacial polymerization is a fast reaction process. The ultrathin PA membranes provide high selectivity due to their ultrathin and dense active layers and hydrophilic nature. But this same property of being dense also hinders the permeability. Introducing thin 2D interlayers can help regulate the IP process and improve surface properties like hydrophilicity, roughness, and effective length of channels, resulting in improved permeance(2). We will use the Vermiculite membranes as the interlayers as they satisfy all the requirements of an ideal interlayer membrane. Previous work has been done on this problem using other materials like MOF,

				MXenes, GO and several others, but there is a lot of scope for improving the performance of the composite membranes. Also, the effect of different variables, like reaction rate, types of intercalants inside the vermiculite membrane, and membrane mass loading, on the performance needs to be checked. Moreover, the fltration process further needs to be optimised for repeatability of the results. We will use the different vermiculite membranes (like K-V, Al-V, Na-V) to check the performance like salt/Dye rejection, permeation flux and hydrophilicity of the membranes. The effect of reaction time and the different mass loadings of the vermiculite membrane layer over the PA layers on the performance will also be checked. The effect of heat treatment on the membrane performance will also be explored. The performance of the membrane for long-term operations and the effect of fee dye/salt concentrations on the selectivity and permeation flux will also be investigated. Reference : 1. Polyamide Thin Film Composite Membranes Using Interfacial Polymerization: Synthesis, Characterization and Reverse Osmosis Performance for Water Desalination 2. Hydrolyzed polyacrylonitrile nanofbers as interlayers for ultrathin nanofltration membranes of high permeance and salt rejection

Wesley Ochieng' Otieno	DNA Barcoding Of Indian Medicinal Plants.	Subramanian Sankaranarayanan	Biological Engineering	DNA barcoding is a highly effective tool for species identification and shows great potential for improving the authenticity and quality control of herbal and Ayurvedic medicines. Traditional identification methods are often slow and impractical for large-scale applications, but DNA barcoding provides a more efficient and reliable alternative. However, identifying subspecies or variants within species poses challenges due to the high sequence similarity of marker genes and the difficulty in accurately distinguishing variants. This study outlines a detailed approach to DNA barcoding for three variants of commonly used medicinal plants in India: Bougainvillea, Plumeria, and Dianthus, using the matK gene as a molecular marker. The matK regions sequenced in this study, ranging from 550 to 700 base pairs, exhibit a variability of between 1-2.7% at the intraspecies level, which facilitates straightforward species identification using high-quality barcodes. Sequence and phylogenetic analyses showed that the DNA barcodes were grouped with the corresponding species' matK gene. The two-dimensional barcodes created for the nine species in this research link to barcode sequences in the NCBI when scanned. These results highlight the significant potential of DNA barcoding as an effective tool for the identification and authentication of species variants, surpassing conventional methods.

Sujal Makwana	UAV-Mounted TDLAS Based Ambient Water Vapour Measurement System	Arup Lal Chakraborty	Electrical Engineering	Accurate measurement of greenhouse gases is essential in the context of rising global emissions. This paper introduces a compact and lightweight Tunable Diode Laser Absorption Spectroscopy (TDLAS) sensor, designed for measuring atmospheric water vapour concentrations from an unmanned aerial vehicle (UAV). The system includes a GSM module for long-distance data transfer, a fiber coupled U-bench (Thorlabs) and a cooling fan for optimal air circulation. Key components are placed in a thermally insulated, lightweight structure. The system, mounted on a hexacopter, was tested at 30.48 m altitude within the IIT Gandhinagar campus, successfully transmitting real-time data without losses.
Himanshu Khatri	Cell culture based methods to screen drugs for cancer treatment	Dhiraj Bhatia	Biological Engineering	Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses, and fungi. AMR occurs when bacteria, viruses, fungi, and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness, and death. As a result, the medicines become ineffective and infections persist in the body, increasing the risk of spread to others. Antimicrobials - including antibiotics, antivirals, antifungals, and antiparasitics - are medicines used to prevent and treat infections in humans, animals, and plants. Microorganisms that develop

				antimicrobial resistance are sometimes referred to as “superbugs”. Antimicrobial resistance (AMR) is a natural phenomenon whereby bacteria evolve in such a way to withstand the action of drugs, making them apparently ineffective. The pressure that antimicrobials put on the pathogens is responsible for the selection of resistant strains Although AMR is a naturally occurring process, and while in the past decades, it was believed to be under control, today it is considered a threat to global health, and the expectations for the future are not encouraging.