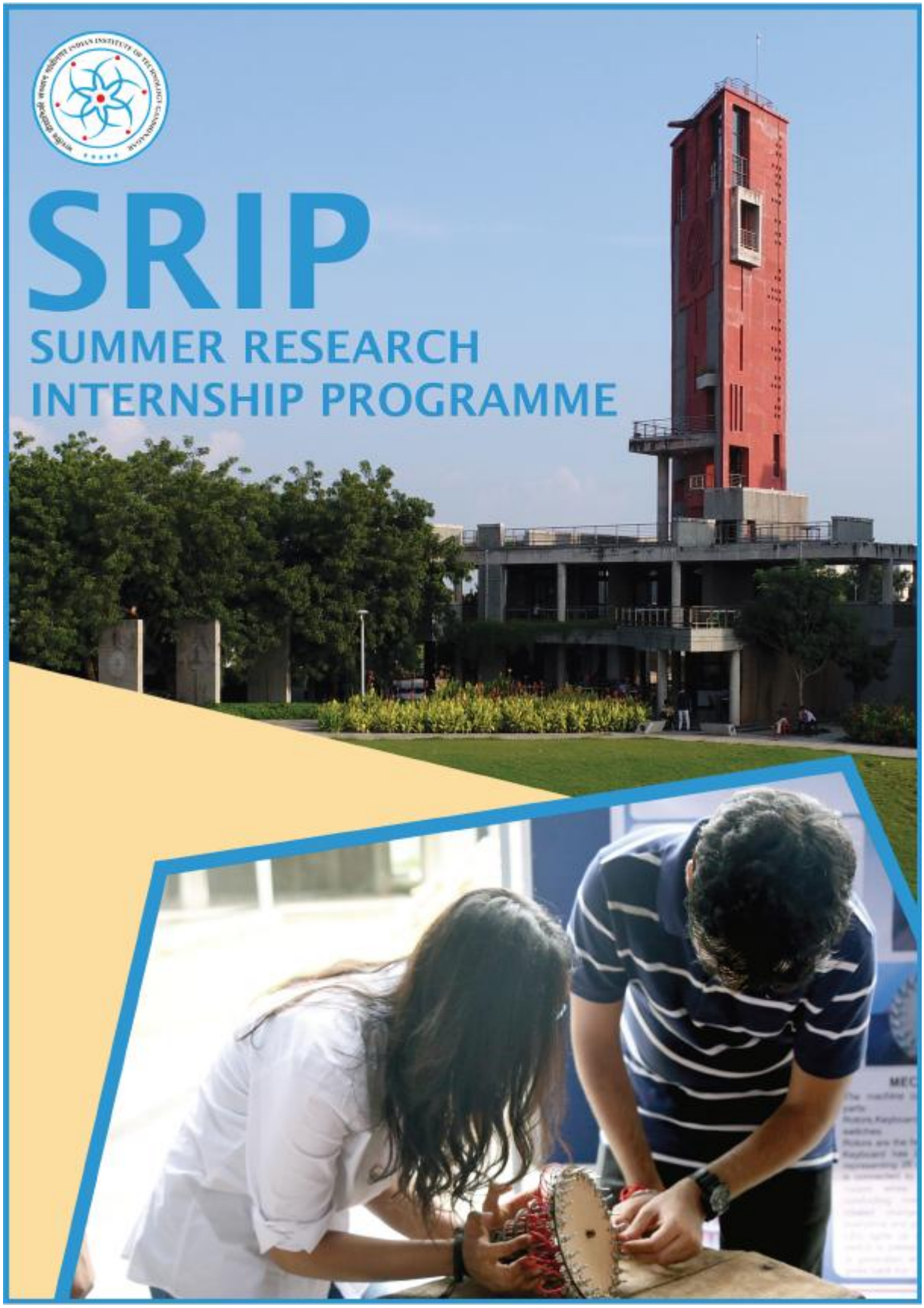

SRIP Report 2025

May – July 2025

Team

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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 2025 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, and 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 manyfold 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) 2025 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 Nithin George and Professor Sameer Patel is put on record. The organizers are thankful to the speakers of the SRIP Lecture Series: Prof. Pallavi Bharadwaj, Prof. Dhiraj Bhatia, Prof. Vaibhav Tripathi, Prof. Sharmishta Majumdar, Prof. Madhav Pathak, Prof. Indranath Sengupta and Prof. Manisha Padala. 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 2025.

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1 SRIP 2025: Statistics

A total of 41,333 internship applications were received for 137 projects offered by 67 IIT Gandhinagar faculty members, making an average of 301+ applications for a project. A total of 236 students were selected for the program (success rate of 0.3 %). Out of 184 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 2025: Activities

2.1. Welcome Session

A welcome session was conducted in the Jasubhai Memorial Auditorium at IIT Gandhinagar on May 24, 2025. 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

The SRIP Lecture Series brought together a diverse set of faculty talks aimed at inspiring students and researchers through thought-provoking ideas, scientific insights, and skill-building discussions. These lectures cover a wide range of themes from personal growth to cutting-edge research, reflecting the interdisciplinary spirit of the program. Eight lecture sessions were conducted as part of the SRIP Lecture Series.

The series began with the inaugural lecture on May 15th, 2025, by Prof. Pallavi Bharadwaj titled “Innovate, Lead, Inspire: How to be a Successful Researcher”. She shared her research journey with the students and explained the qualities required to be a successful researcher. This was This was followed by a talk on May 22nd by Prof. Dhiraj Bhatia, who delivered an engaging session on “Beating Procrastination” addressing one of the most common challenges faced by students and professionals alike. The next talk was by Prof. Sameer Sahasrabhudhe, who spoke on May 29th,

and his talk was titled “Poster Perfect: A Guide to Presenting Your Internship work”, providing essential skills for effective research communication.

The next session was on June 5th by Prof. Vaibhav Tripathi, who explained the fascinating world of neuroscience in his lecture “Wired to Wonder: Exploring the Human Brain”. Later in the month, on June 19th, Prof. Sharmishta Majumdar delivered a talk titled “How curiosity and out-of-the box thinking have continued to push the boundaries of Science”. This inspiring discussion revolved around the value of creativity in scientific discovery. Later, on June 26th, Prof. Madhav Pathak gave a talk titled “India Semiconductor Mission and Opportunities Ahead”, shedding light on a domain that is shaping the future of technology and Industry. The next talk on June 30th by Prof. Indranath Sengupta was titled “Problems of Antiquity: Tales of Impossibility” where he delved into the historical and mathematical challenges that have intrigued scholars for centuries. The last talk of this series was by Prof. Manisha Padala on June 30th, where she shared her expertise through a lecture titled “Adversarial Attack for Compromising Group Fairness in Federal Learning”, highlighting crucial issues in AI and machine learning ethics.

The SRIP Lecture Series thus served as both a learning platform and a source of inspiration, combining personal development, career skills, fundamental science, and futuristic research directions for the benefit of the student community.

2.3 SRIP Poster Session

A poster session was organized at the end of the SRIP on July 9, 2025. The students presented posters of their work done during the summer. More than 100 posters were presented by the summer interns of SRIP 2025. The posters were evaluated by a panel of judges comprising Professors Bireswar Das, Uddipta Ghosh, Krista, Sandip Lashkare, Anirban Mondal, Malay, Manisha Padala, Sushobhan Sen, Achyut, Sonal, Anagh, Shouvick, Hari Ganesh, Abhinav, Abinaya, Biswajit Mondal, and Sumit Tembe. The panel of judges also consisted of senior Ph.D. students and postdoctoral researchers (Naina, Baint, Charli, Tarisha, Faraz, Gayatri, etc.).


2.4 AICTE SAMARTHAN: INTERNSHIP CONNECT 2025-26

The internship is for undergraduate and postgraduate students from the domicile of J&K, Ladakh, and the Andaman and Nicobar Islands. 36 interns from various disciplines have completed this 15-day summer internship program.

3 SRE Award

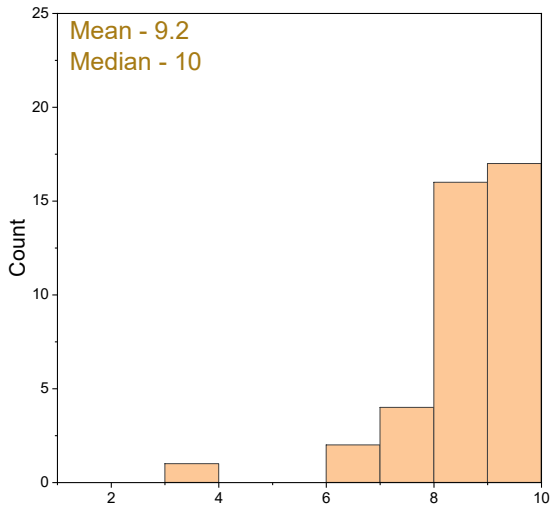
The Bhalodia-Khetan Summer Research Excellence Award aims to recognize outstanding undergraduate research internships in Engineering, Natural Sciences and Humanities, and Social Sciences each year. As approved by the Board, one award in each category is to be given each year.

For SRIP 2025, the filtering process for the award was the voluntary SRIP poster presentation event held on July 09, 2025, during which 111 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, the committee recommended the following individuals for the award.

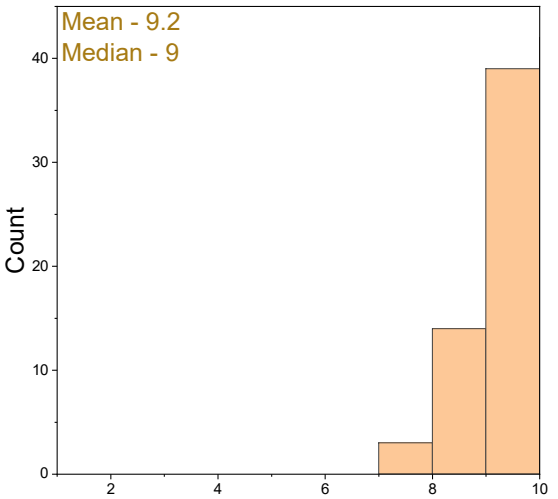
1. *Engineering:* **Ayush Singh**, B.Tech., Mechanical Engineering, PDEU, (advised by Prof. Manish Kumar)
2. *Science*: **Anit Suresh Kuckian,** M.Sc., Mathematics, IIT Gandhinagar**,** (advised by Prof. Indranath Sengupta)
3. *Humanities and Social Sciences*: **Omisha Vaish**, M.Sc., Survey Research and Data Analytics, International Institute for Population Sciences, (advised by Prof. Deepak Singhania)

The winners received the award of INR 50,000 on August 15, 2025, 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 Name	Department/ Discipline	Abstract
A S Aravinthakshan	AI/ML based climate data downscaling	Vimal Mishra	Civil Engineering	Accurate, timely, and actionable flood forecasting has potential for reducing flood risk but remains challenging due to uncertainty in meteorological forecasts, poor hydrological observations, and increasing forecast errors with lead time. While Long Short-Term Memory (LSTM) models have surpassed conventional hydrological forecasting models, they often struggle to capture the timing and magnitude of extreme floods due to long-range dependencies and static feature importance. Here, we propose a sequential LSTM with Multi-Head Attention (SeqLSTM-MHA) to improve 1-3 day ahead flood forecasts, explicitly using historical hydrometeorological and upstream hydrological observations. SeqLSTM-MHA attained NSE of 0.70-0.90 for water level and 0.65-0.80 for streamflow, outperforming traditional LSTMs, decision tree-based models, and multiple linear regression by more than 30%. The model shows strong skill in forecasting extremes, with NSE exceeding 0.6, and accurately captures over 75% of peak magnitudes. Our findings demonstrate the potential of attention-based LSTM for operational flood forecasting, particularly for high-impact events.

Aarthi Venkatesh	Neural correlates of Tactile Perception - behavioral & computational approach	Leslee Lazar	HSS	The ability to feel, touch and perceive is often a special superpower that people possess to discriminate and make sense of things around them. But, what if one of the senses such as vision is lost? Does the superpower of being able to touch get heightened when one of your other senses is lost? The idea that when one loses a particular sense remaining senses get heightened can be traced back to the age of Darwin. He claimed that — When we direct our whole attention to any one sense, its acuteness is increased; and the continued habit of close attention, as with blind people to that of hearing, and with the blind and deaf to that of touch, appears to improve the sense in question permanently. (p. 361) The long-held belief that sensory deprivation can enhance remaining senses has sparked considerable debate within the scientific community over the years. It is worth noting that a number of modern studies support Darwin's belief that blindness enhances other senses abilities. For instance, It has been well documented that visually challenged individuals have superior auditory spatial localisation abilities (Lessard et al., 1998; Röder et al., 1999; Wan et al, 2010). However, the notion that blindness results in heightened sensory abilities, particularly in the domain of touch perception, has been a topic of considerable debate. The controversy persists as researchers continue to explore whether the loss of vision truly leads to superior tactile or auditory abilities, or whether these perceived enhancements stem from alternative mechanisms of neural adaptation. This ongoing discussion has prompted diverse methodological approaches to investigate the complex relationship between visual loss and perceptual compensation. Two leading hypotheses have been proposed to understand increased sensory sensitivity in congenital blindness. According to the sensory deprivation hypothesis, mere absence of vision leads

				to compensatory changes in other senses leading to enhanced ability to perform in non-visual tasks by the blind(Slimani et al, 2015). In contrast, the training induced hypothesis suggests that the mere absence of vision does not lead to enhanced non visual ability but rather this enhancement in the ability to perform stems from training induced plasticity (Slimani et al, 2015). Tactile spatial resolution (i.e,the ability of the skin (especially fingertips) to distinguish between two closely spaced touch stimuli.) is often measured and understood through two methods — 1) Active paradigms (i.e,. voluntary movements to explore the environment) and 2) passive paradigms (i.e, when the object is presented to the hand without active exploration). For years now, the accurate assessment has been challenging as active paradigms may be confounded by variability in motor strategies employed by blind and sighted individuals, thereby limiting the validity of cross-group comparisons. Conversely, passive paradigms—often utilized to minimize motor involvement—have typically relied on tasks such as two-point discrimination, which are susceptible to unintended nonspatial cues that may compromise the spatial specificity of tactile performance measures (Craig & Johnson, 2000). Unfortunately, many tasks administered for a long while were manually applied, which may lead to variability in responses with respect to force or velocity (Goldreich & Kanics). To resolve inconsistencies, researchers developed a variety of tactile assessments: Two point discrimination task, Grating orientation task, londolt ring tests, pattern recognition test, 2 Dimensional angle discrimination task, haptic shape discrimination task, von frey hair task, vibrotactile task, thermal and pain tasks have been developed over the past 20 years. While there has already been extensive research on the understanding of tactile acuity among blind and sighted individuals, we seek to understand and compare tactile acuity

				among the blind and sighted individuals using the GOT task, two point discrimination task and a vibrotactile task that measures the reaction time, sequential amplitude, amplitude discrimination task, timing task and duration discrimination task. In this study, we aim to investigate whether there is a significant difference in tactile acuity between blind (BL) and sighted (SI) individuals by using both active and passive paradigms — Grating Orientation Task (GOT), Two-Point Discrimination (2PD), and vibrotactile tasks. While previous research has primarily explored tactile acuity through frequency discrimination (Wan et al., 2009), we extend this line of inquiry by employing a broader range of vibrotactile measures—Reaction Time, Sequential Amplitude Discrimination, Amplitude Discrimination, Timing Discrimination, and Duration Discrimination. By doing so, we seek to provide a more comprehensive assessment of tactile perception differences between BL and SI individuals, potentially uncovering novel insights into how visual deprivation shapes tactile processing across diverse task demands. Previous research suggests that blind individuals may exhibit enhanced tactile sensitivity, likely due to cross-modal plasticity and adaptive sensory training. However, this enhancement is not necessarily uniform across all tasks or individuals. Factors such as the age of onset of blindness, Braille reading experience, and daily tactile reliance may modulate tactile processing abilities. By comparing blind and sighted individuals and further stratifying blind participants by Braille expertise this study aims to disentangle global sensory differences from experience-dependent plasticity in tactile sensitivity. We hypothesize that blind individuals will demonstrate higher tactile acuity than sighted individuals in tasks that are manually administered (GOT & 2PD).

				Furthermore, we hypothesize that within the blind group, individuals with higher Braille-reading expertise will exhibit superior tactile acuity compared to Braille beginners, reflecting the effects of experience-dependent tactile refinement.

Aarti Yadav	Developing specific molecules to study the mechanism of disease oriented proteins	sivapriya kirubakaran	Biological Engineering	Tousled-like kinase 1 (TLK1) is a serine/threonine protein kinase involved in critical cellular processes such as DNA replication, chromatin assembly, and repair. Due to its intrinsic flexibility and relatively low molecular weight (~64 kDa), obtaining high-resolution structural data on TLK1 through cryo-electron microscopy (cryo-EM) remains challenging. This project aimed to enhance the molecular weight and stability of TLK1 by engineering a fusion with Maltose-Binding Protein (MBP), a 42.5 kDa solubility-enhancing tag commonly used in structural biology. The fusion construct, TLK-MBP, was cloned into an appropriate plasmid, transformed into competent E. coli Rosetta-gami cells, and expressed under optimized conditions. Protein purification was performed using Ni-NTA affinity chromatography, followed by SDS-PAGE analysis to confirm expression and assess purity. The final fusion protein exhibited an expected molecular weight of approximately 110 kDa, making it more suitable for cryo-EM-based structural studies. This approach not only improves the chances of obtaining a high-resolution 3D structure of TLK1 but also contributes to future drug discovery efforts by facilitating structural and functional Tousled-like kinase 1 (TLK1) is a serine/threonine protein kinase that is integral to several critical cellular processes, including DNA replication, chromatin assembly, and repair. However, the intrinsic flexibility and relatively low molecular weight of TLK1 (approximately 64 kDa) present significant challenges in obtaining high-resolution structural data through cryo-electron microscopy (cryo-EM). To address these challenges, this project focused on enhancing the molecular weight and stability of TLK1 by engineering a fusion with Maltose-Binding Protein (MBP), a 42.5 kDa tag known to improve solubility in structural biology applications. The resulting fusion construct, designated TLK-MBP, was successfully cloned into an appropriate plasmid and then transformed into

				competent E. coli Rosetta-gami cells to facilitate expression under optimized conditions. Subsequent protein purification was conducted using nickel-nitrilotriacetic acid (Ni-NTA) affinity chromatography, followed by SDS-PAGE analysis to confirm the expression levels and assess the purity of the fusion protein. The final product exhibited an expected molecular weight of approximately 110 kDa, making it more suitable for structural studies using cryo-EM. This approach significantly enhances the prospects of obtaining a high-resolution 3-D structure of TLK1. Other than that, it contributes to future drug discovery initiatives by enabling detailed structural and functional analyses of this therapeutically relevant kinase. Analyses of this therapeutically relevant kinase.

Abhi Ketan Panchal	Electrochemical Experiments for Science Education	Manish Jain	Creative Learning	Electrochemistry is a core topic in science education, yet often taught through static diagrams and abstract theory, leading to misconceptions—such as confusing anode/cathode roles or misunderstanding electron flow. These gaps limit students' ability to apply foundational concepts to real-world applications like corrosion, electrolysis and material behaviour in suitable solvent Despite electrochemistry's growing relevance in energy, materials science, and sustainability, it remains underrepresented in curricula. Teachers often lack confidence and resources to teach it effectively, while textbooks sometimes reinforce incorrect ideas. Even where it is part of the curriculum, it is frequently taught without hands-on experience or contextual relevance, contributing to shallow learning. This project proposes a low-cost, safe, and engaging microscale electrochemistry kit to support active, contextual learning for high school and undergraduate students, while also aiding teacher development.

Abhi Raval	Makerbot 2.0	Maker Bhavan	All Departments	This report details my software development work on MakerBot 2.0, a smart robotic assistant created during my SRIP 2025 internship at Maker Bhawan, IIT Gandhinagar. Unlike typical voice assistants, MakerBot 2.0 uses computer vision to recognize faces, greet known users by name, and track people with head movements, making interactions more natural. MakerBot 2.0 represents a significant advancement in human-computer interaction, combining artificial intelligence, computer vision, and robotics to create an intelligent assistant specifically designed for the Maker Bhavan at IIT Gandhinagar. This project, completed during the SRIP 2025 internship, addresses the growing need for intuitive, natural interaction between humans and robotic systems in educational and laboratory environments.

Abhitej Singh Bhullar	Development of an AI-based surrogate model for isotropic and orthotropic slabs	Sushobhan Sen	Civil Engineering	This project was done under the guidance of Prof. Sushobhan Sen, IIT Gandhinagar, in the Summer Research Internship Program, May-July 2025. I developed a flexible and efficient deep learning pipeline to downscale daily climate outputs (e.g., CMIP-6) into 24-hour temperature profiles for multiple weather stations across India. Hourly temperature data is essential for predicting asphalt pavement performance because it captures daily thermal cycles that significantly affect the material's behavior. Unlike daily averages, hourly data reflects temperature extremes and timing, which influence rutting during peak heat, thermal fatigue due to expansion and contraction, and freeze-thaw cycles in colder regions. These variations impact the stiffness, cracking potential, and overall durability of asphalt layers. Accurate hourly temperatures are especially important for mechanistic-empirical design tools and long-term climate-resilient pavement modeling. I built ANN and RNN models which were trained on the historical hourly temperature data (ERA5) of 8 different locations in India and evaluated on 2 new locations to see the performance of the model. The main idea was to input the minimum and maximum temperature values of a day and get the 24 hour temperature values of that day. However, we know that the weather on the previous day (or 2 days back) can have some relation to the weather on the current day. It also depends on the day of the year too, which accounts for the seasonal changes. Thus I made 3 models each for ANNs and RNNs - varying the number of min. and max. temperatures being given as inputs.

ABIR BHATTACHARYA	Industrial wastewater treatment	Chinmay Ghoroi	Chemical Engineering	Microalgae are unicellular photosynthetic organisms renowned for their rapid growth and ability to synthesize a diverse array of bioactive compounds. Among them, Chlorella vulgaris stands out due to its robust adaptability and high productivity, making it a prime candidate for various biotechnological applications. C. vulgaris is a prolific producer of value-added products, including lipids suitable for biodiesel production, proteins for animal feed, carbohydrates for bioethanol, and pigments like chlorophyll and carotenoids utilized in nutraceuticals and cosmetics. Its protein content can range from 42% to 58% of its dry weight, and it also contains significant amounts of lipids (5–40%) and carbohydrates (12–55%), depending on cultivation conditions (Safi et al. 2019). Beyond its biosynthetic capabilities, C. vulgaris exhibits significant potential in bioremediation. It efficiently assimilates nutrients and pollutants from wastewater, such as nitrogen, phosphorus, and organic compounds, thereby reducing chemical oxygen demand (COD) and improving water quality . Studies have demonstrated its efficacy in removing up to 98% of nitrate, 95% of phosphate, and 91% of COD from industrial textile wastewater, highlighting its potential in treating various wastewater sources (Abdel-Raouf et al. 2023). This dual functionality positions C. vulgaris as a sustainable solution for simultaneous wastewater treatment and biomass generation

Acharya Vedant Vijaykumar	AI/ML for Sustainability	Nipun Batra	Computer Science	Air pollution is a pressing global issue, yet stakeholders, ranging from citizens to policy makers, face barriers to translating air quality sensor data into actionable insights. To explore whether large language models (LLMs) can bridge this gap, we introduce AQBench, a benchmark to evaluate LLMs' ability to generate code that answers structured queries over real-world air quality datasets. AQBench includes 10,030 self-created air pollution–related queries paired with ground-truth Python code, across seven types, covering spatial, temporal, and policy-relevant aspects. The queries are based on curated tabular data on pollution levels, funding, and state-wise population. We evaluated multiple open-source LLMs under a unified setup, fine-tuning smaller models. Qwen3-4B_FT achieved the best pass@1 score of 0.94, while Llama-3.2-1B showed the highest syntactic error rate (0.9630). AQBench aims to enable safe, robust, and LLMs capable of helping in environmental monitoring, public engagement, and policy support.

Aditi Pandey	Computational investigation of carbohydrate dynamics in protein-carbohydrate complexes.	sairam swaroop mallajosyula	Chemistry	With a particular focus on α-Altrose and α-Mannose, this work resolves significant differences in classical force field predictions regarding the conformational dynamics of hexose monosaccharides. As demonstrated by the incorrect oversampling of the 1C4 chair conformation for α-Altrose, existing force fields frequently misrepresent the flexibility of these important biomolecules. In order to address this, we used high-level quantum mechanical (QM) computations at the MP2/6-31+g(d) level, conducting methodical two-dimensional (2D) scans of the potential energy surface (PES) across important ring dihedral angles. NMR J-coupling values were computed and averaged from these fine-grained landscapes, and Boltzmann population distributions were obtained. Our findings clearly show that α-Altrose has much greater conformational flexibility, with broad energy basins and six different minima. The 4C1 chair was correctly identified as its global minimum, which is in direct opposition to earlier force field assignments. α-Mannose, on the other hand, exhibits a more constrained conformational landscape with seven different minima. Additionally, our QM-derived structures and populations are validated by the calculated Boltzmann-weighted average J-couplings, which exhibit excellent agreement with experimental NMR data. This work improves the accuracy of biomolecular simulations that are vital for drug discovery and advances glycoscience by offering strong, high-accuracy QM benchmarks that are necessary for the future validation and improvement of molecular mechanics force fields.

Aditi Thakar	Retrodicted Trajectories for Superradiance	B. Prasanna Venkatesh	Physics	A collection of quantum emitters separated by a distance smaller than the emission wave length radiates collectively, and correlations are created among them, leading to the phe nomena of super-radiance and sub-radiance. These collective emission effects arise due to inter-emitter interactions via the shared environment. Subradiance is a phenomenon where emitters radiate at a rate lower than their individual decay rates. Such Subra diant states have various applications, including energy storage, quantum information processing, nano-optics, and photonic devices, owing to their prolonged lifetime. How ever, generating these states is challenging. The conventional approach involves designing special emitter geometries or achieving imperfect collective emission, both of which are not very efficient. This work proposes an alternative method to generate subradiant states using quantum measurement as a tool. Such measurement-induced subradiance can be efficiently achieved by varying the measurement rates and basis. The report presents a detailed discussion and numerical results demonstrating this approach.

Aditya Mehta	Molecular Dynamics Simulations of Proteins	Karthik Subramaniam Pushpavanam	Chemical Engineering	Solid Binding Peptides (SBPs) are short amino acid sequences capable of selectively binding to various surfaces. While phage display is a traditional method for identifying SBPs, it can miss high-affinity binders due to experimental limitations. In this work, we use molecular dynamics simulations to re-evaluate 46 literature-curated peptides—originally intended for various materials—to identify new and stronger binders for the Au(111) gold surface. Benchmarking against the reference peptide p7, we discover several peptides that show significantly enhanced interaction energies. We also propose peptide design guidelines based on sequence composition, length, structural flexibility, and charge distribution.

Adwaith P	Molecular Dynamics Simulations of Proteins	Karthik Subramaniam Pushpavanam	Chemical Engineering	Peptides with the ability to selectively attach to inorganic surfaces are essential for advancing nanotechnology, biomaterials, and biosensing technologies. In this research, Aditya Mehta (Chemical Engineering, IIT Gandhinagar) and I used MD simulations to evaluate the binding strength of 46 peptides, carefully selected from existing literature, to the Au(111) gold surface. Through detailed computational analysis—measuring interaction energies, RMSD, and distances to the surface- we identify key factors influencing peptide-gold interactions. Our findings show that certain peptides not traditionally recognised as gold-binding exhibit even higher affinity than those identified experimentally. This highlights new possibilities for using unconventional peptides in gold-based technologies.

Agneesh Pramanik	Droplet transport on wettability patterned surfaces	Soumyadip Sett	Mechanical Engineering	Efficient pesticide deposition on plant foliage is critical for sustainable agriculture but is often hindered by the hydrophobicity and mechanical compliance of leaf surfaces. This study explores the impact dynamics of water droplets on synthetic superhydrophobic PTFE substrates engineered to mimic the surface properties and flexibility of young plant leaves. Experiments were conducted across a range of Weber numbers and inclination angles, with both rigid and flexible surfaces, using high-speed imaging and quantitative image analysis. Key parameters such as spreading diameter, contact time, surface deflection, and sliding distance were extracted. Results demonstrate that flexible substrates absorb a portion of the droplet's kinetic energy, leading to reduced spreading and increased rebound likelihood. Inclined surfaces further modulate droplet behavior through altered normal and tangential force components. Comparative analysis reveals that both flexibility and inclination significantly influence droplet retention. These findings have direct implications for optimizing precision spraying systems in agriculture, highlighting the need for adaptive, angle- and stiffness-responsive nozzle technologies to reduce pesticide wastage and environmental contamination.

Ahana Chatterjee	Fiber Bragg grating (FBG)-based microphone	Arup Lal Chakraborty	Electrical Engineering	This project focuses on the frequency characterization of solid surfaces such as steel and wood using piezoelectric sensors. A vibration motor was used to excite the surface at varying voltage levels, and the sensor responses were analyzed to understand the propagation of vibrations across the surface. Due to limitations in the motor's frequency range and environmental noise, full frequency analysis across multiple points was constrained. Despite this, the project successfully highlights the potential of piezoelectric sensing in vibration analysis and sets the stage for future improvements with more advanced actuators and data acquisition systems.
Akash Saji	Fiber Bragg grating (FBG)-based microphone	Arup Lal Chakraborty	Electrical Engineering	We present the design of a Fiber Bragg Grating based microphone suitable for surveillance purposes with a low cost membrane and a standard 3D printed backplate. This fully integrated approach provides a tool for in-room surveillance and is suitable for educational demonstrations.

AMREESH	Green chemistry: Photocatalysis by metal free organic dyes	Iti Gupta		Title: Photocatalytic Exploration of Secondary Amines Tetrahydroisoquinolines (THIQs) are a class of chemical compounds that are widely found in natural products, pharmaceuticals, and biologically active molecules. Their unique structure makes them highly useful in medicinal chemistry and drug development. One important derivative is N-phenyl tetrahydroisoquinoline, which serves as a key intermediate in the synthesis of several drugs.1 For example, it plays a critical role in the production of solifenacin succinate, a drug used to treat an overactive bladder. THIQ is a privileged scaffold for the design and development of novel anticancer agents. Because of their value, scientists are interested in modifying THIQs to create new compounds with improved or unique properties. In this project, we aim to develop new methods to functionalize THIQ derivatives.2 We will focus on synthesizing and characterizing a series of THIQ compounds that have different chemical groups attached to them, using variable characterization techniques like HRMS, NMR, etc. The goal is to explore how these changes affect their reactivity in visible light-mediated catalysis, where light will be used as a clean source of energy.3 This makes the process more sustainable and reduces the need for harsh chemicals or high temperatures. References: 1. Faheem, B. Karan Kumar, K. Venkata Gowri Chandra Sekhar, S. Chander, S. Kunjiappan and S. Murugesan, Expert Opinion on Drug Discovery, 2021, 16, 1119–1147. 2. M. Scott, A. Sud, E. Boess and M. Klussmann, J. Org. Chem., 2014, 79, 12033–12040. 3. C. K. Prier, D. A. Rankic and D. W. C. MacMillan, Chem. Rev., 2013, 113, 5322–5363.

Aniket Kumar	Elasticity, Slab bending and Earthquake occurence in 3D	Utsav Mannu	All Departments	Subduction zones are key sites for understanding plate tectonics, seismic hazard, and lithospheric dynamics. A well-documented empirical observation is that subduction-related seismicity in the mantle ceases above ~600 °C, correlating seismic activity with the thermal structure of the subducting slab. Surprisingly, regions such as the Aegean, the Caspian, and the Indo-Burman Range—characterized by thick sedimentary covers (10–25 km)—exhibit deep seismicity (>150 km), defying expectations that such thick, low-conductivity sediments would significantly warm the subducting lithosphere and limit the depth of earthquake generation. McKenzie and Jackson (2020) demonstrated through thermal modeling that sedimentation—even when thick and rapid—does not significantly alter the temperature structure of the lithosphere over ~40 Ma, allowing for continued deep seismicity. However, their work was primarily focused on thermal evolution due to sediment blanketing. This proposal extends their work by systematically analyzing how sedimentation rate, sediment thickness, and initial thermal states of the lithosphere influence the depth and extent of the seismogenic zone. Specifically, we aim to incorporate more dynamic aspects of slab evolution using full 2D geodynamic models solved with the i2ELVIS code, including not only thermal diffusion but also conservation of mass, momentum, and energy.

Anirudh Mittal	Hardware-Software Co-design of AI hardware accelerator	Joycee Mekie	Electrical Engineering	Matrix multiplication is a core computational primitive in signal processing, scientific computing, and machine learning, yet its inherent O(n3) complexity makes it a major performance bottleneck on sequential processors. This report presents a hardware-accelerated implementation of matrix multiplication through a custom instruction extension to the RV32IM RISC-V core. A dedicated systolic array accelerator is integrated into the five-stage RISC-V pipeline via a custom matmul instruction, with modifications made to both the GNU RISC-V toolchain and the Spike simulator for software simulation. The Verilog-based hardware architecture incorporates a wrapper for operand control, a counter for profiling, and UART for runtime validation. The complete system was prototyped on a Xilinx Nexys4 DDR FPGA, and performance profiling via waveform analysis and post-implementation timing reports demonstrated a substantial reduction in execution cycles, reducing the effective computational complexity significantly. This work underscores the potential of custom ISA extensions and domain-specific accelerators in advancing the performance of open-source

				RISC-V-based embedded computing platforms.
Anit Suresh Kuckian	Groebner and SAGBI bases in Commutative Algebra and its applications	Indranath Sengupta	Mathematics	We study a two-dimensional family of affine surfaces which are counter-examples to the Zariski Cancellation problem. These are known as the ``double Danielewski surfaces''. We explicitly compute solutions to these surfaces, in the Monomial Case, over a finite field.

ANJALI	Machine learning approaches for prediction of hydrological extremes	Vimal Mishra	Civil Engineering	Accurate streamflow prediction plays a vital role in managing water resources, reducing flood risks, operating reservoirs, and planning for climate change adaptation. In a country like India, where the economy and livelihoods are closely dependent upon the monsoon and river systems, the ability to forecast streamflow with high spatial and temporal precision is essential. Furthermore, the presence of dams and their operations introduces additional complexity into streamflow dynamics, which must be accounted in hydrological modelling. This study employs the Variable Infiltration Capacity (VIC) model—a physically-based, semi-distributed hydrological model that simulates key land surface processes such as infiltration, evapotranspiration, soil moisture movement, and baseflow generation. VIC's strength lies in its ability to model large-scale water and energy balances while accounting for local variability in land cover, soil, and topography. The recent development (VIC-Res) introduces the incorporation of reservoirs within the routing module and auto-calibration feature enables us to use the model at their best capabilities. To enhance prediction accuracy and address limitations of physical modelling alone, this research will also incorporate Machine Learning (ML) techniques. Model performance will be assessed using evaluation metrics such as Nash-Sutcliffe Efficiency (NSE), and Correlation Coefficient (R^2). The combined VIC-ML approach aims to create a robust, accurate, and practical framework for streamflow forecasting to support sustainable water resource planning and disaster risk reduction.

ANJALI	Identifying the protein interacting partners of lncRNAs dysregulated in various cancers	Sharmistha Majumdar	Biological Engineering	The intricate interactions between lncRNAs and RNA-binding proteins (RBPs) play pivotal roles in gene regulation, epigenetic remodeling, and cellular signaling pathways. Long non coding RNAs dysregulated expression is implicated in numerous pathological conditions like neurodegenrative disorders, cancers, and autoimmune disorders. Understanding the interaction between lncRNAs and associated proteins is crucial to understand disease mechanisms and development of novel therapeutics. ChIRP-MS enables high throughput discovery of RNA-bound proteins without prior assumptions about binding partner of RNAs. The primary research question addressed in this study was: “How can ChIRP-MS be optimized to comprehensively identify and characterize RNA-binding proteins and long non-coding RNA interactions with enhanced specificity and sensitivity?” The optimization study was conducted using HT-29 colorectal cancer cell line. The project involved systematic troubleshooting across four distinct phases. The first phase focused on optimization of sample processing steps including evaluation of proteinase k, reverse crosslinking, and comparative analysis of DNA clean up procedure. The second phase included optimization of the sonication cycle through testing various ranges of sonication cycles and pulse settings. The third phase assessed cell lysis optimization by evaluation of different lysis buffers. Additional buffers like RIPA and G4RP were also evaluated for comparison. The final phase assessed formaldehyde concentrations 1% and 3% for crosslinking. The research identified post sonication DNA clean up leading to substantial sample loss, emphasizing importance of raw lysate for downstream ChIRP-MS. The research identified optimum lysis buffer conditions i.e 1% SDS concentration lead to effective lysis. Sonication optimization demonstrated that cycle 10 and pulse settings 30 s on/45 s off achieved optimal chromatin shearing. Optimization of sample processing established proteinase k

				treatment+reverse crosslinking proved to enhance smear intensity. The optimized ChIRP-MS protocol established a robust foundation for comprehensive RNA-protein interaction studies. The verified parameters enable the next phase of research which involves hybridization of biotinylated antisense probes to target RNAs, followed by streptavidin based pulldown and mass spectrometric identification of bound proteins. Given the emerging evidence of G-quadruplex structure formation in cancer-dysregulated lncRNAs, the improved ChIRP-ms can be a valuable tool to identify structure-guided RNA-protein interactions that may serve as novel therapeutic targets. This comprehensive optimization study addressed the key technical challenges in ChIRP-MS methodology, established standardized parameters that significantly improve protocol reliability and reproducibility.

ANJALI PRAMOD	Hydrodynamic Stability Analysis of Complex Flows Using Meshless Methods	Vinod	Mechanical Engineering	This study presents a numerical analysis of Spherical Couette Flow (SCF) in a narrow-gap setup, focusing on the co-rotation of both the inner and outer spheres. The incompressible Navier–Stokes equations are formulated in spherical coordinates and solved using a pseudo-spectral method within the Dedalus framework. A comprehensive parametric investigation is conducted by varying the Reynolds number and the ratio Re_o/Re_i . The results offer insights into the flow responses under dual-rotation conditions and highlight the emergence of distinct flow features across the examined Reynolds number range. These findings enhance the understanding of pre-instability behavior in rotating fluid systems.

Anshu Patra	Optimization of the inductor for high-frequency circuits (above 50 GHz)	Tarun Kumar Agarwal	Electrical Engineering	This paper presents the design, simulation, and analysis of a high-Q single-turn on-chip spiral inductor optimized for mm-wave applications (0.1-250 GHz) using 180nm CMOS technology. The inductor features a novel square geometry with rounded corners, achieving a peak quality factor (Q) of 41.6 at 208 GHz with an inductance of 80-85 pH, demonstrating excellent performance for sub-THz applications. The design incorporates a high-resistivity silicon substrate, optimized guard ring structure, and patterned ground shield to minimize substrate losses. Additionally, a reverse artificial neural network (ANN) model is developed to enable rapid design optimization by predicting required geometric parameters (radius, thickness, width) based on target Q-factor and inductance specifications. The simulation results, obtained using ANSYS HFSS, validate the inductor's superior performance characteristics and demonstrate the effectiveness of the proposed design methodology for mm-wave integrated circuit applications.

Anurag Singh	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	This report offers a comprehensive study of compositional audio to image synthesis using diffusion based models. We begin by reviewing recent state-of-the-art approaches, detailing the datasets, metrics, and model architectures they employ. Building on these insights, we introduce a novel framework that combines audio tokenization with an attention-boosting mechanism to enhance compositional fidelity. We validate our approach on standard benchmark datasets, demonstrating its ability to accurately render multiple concurrent audio cues. Finally, we conclude with a discussion of potential future extensions of our work.

Anushka sahu	Computational investigation of carbohydrate dynamics in protein-carbohydrate complexes.	sairam swaroop mallajosyula	Chemistry	A comprehensive quantum chemistry-based conformational analysis of two hexosepyranoses, β-D-altropyranose and β-D-mannopyranose, was performed. Utilizing rigorous 2D quantum dihedral energy scans coupled with MP2/6-31G(d) optimizations, we thoroughly investigated their conformational landscapes in solution, aiming to overcome the known limitations of earlier classical force field-based investigations. Our results, rigorously validated against experimental NMR 3JH–H coupling constants using Boltzmann-weighted averaging, clearly demonstrate that β-D-mannopyranose maintains a predominantly rigid 4C1 chair conformation. In contrast, β-D-altropyranose exhibits significant conformational heterogeneity, dynamically interconverting between various chair and and skew forms, a finding that directly resolves previously observed discrepancies in its calculated NMR parameters. This work highlights the critical role of quantum level modeling for accurate carbohydrate characterization and for the essential validation and refinement of next-generation carbohydrate force fields, paving the way for more reliable molecular simulations.

ANUSREE CHILAMANATH	Plug and Play Tool for Electric Vehicle Safety Enhancement	Pallavi Bharadwaj	Electrical Engineering	Most Electric Vehicles (EV) accidents occur during charging due to issues such as overcurrent, overheating, and short circuits. These safety concerns can be addressed by adopting a contactless charging system based on magnetic levitation. This study explores the use of permanent magnets to achieve stable magnetic levitation for contactless Electric Vehicle (EV) battery charging. The aim is to design a frictionless, wear-free platform that operates without electromagnets or external power sources. A 3D model was simulated in ANSYS Maxwell using top and bottom cylindrical magnets and an ellipsoidal group object embedded with a cubical magnet. Lateral stability was improved using four side magnets with low remanent flux density. The results validate the feasibility of purely passive levitation for compact EV charging systems. Keywords: Electric Vehicles, safety, Magnetic Levitation, Permanent Magnets, ANSYS Maxwell.

Arihant Jain	Micropaleontology and Paleoclimate of Mid-Miocene Quilon Formation, Kerala Basin	Sonal Khanolkar	Earth Science	The Mid-Miocene epoch witnessed major climatic transitions, including the Mid-Miocene Climatic Optimum, significantly influencing sedimentation patterns in the Kerala and Kutch basins. This project, conducted under the guidance of Prof. Sonal Khanolkar at IIT Gandhinagar, aimed to study foraminiferal assemblages and clay mineralogy of the Quilon Formation to reconstruct paleobathymetry and depositional environments. Although the intern joined after the field expedition, extensive lab-based work was carried out on 20 samples from the Paravoor section (KL/25/PV-1 to KL/25/PV-20). Laboratory processes included foraminiferal extraction through wet sieving and microscopy, as well as clay analysis via XRD and XRF techniques. Observations revealed diverse foraminiferal morphologies and characteristic mineral peaks, contributing to an improved understanding of Miocene marine settings in southwest India. Literature review further supported a Burdigalian age and linked the Quilon Formation to Indo-Pacific seagrass ecosystems. The internship enabled interdisciplinary learning, integrating geoscientific methods with engineering-based analytical skills.

Arjun Anand Mallya	Hardware realization of RISC-V	Joycee Mekie	Electrical Engineering	Matrix multiplication is a core computational primitive in signal processing, scientific computing, and machine learning, yet its inherent $O(n^3)$ complexity makes it a major performance bottleneck on sequential processors. This report presents a hardware-accelerated implementation of matrix multiplication through a custom instruction extension to the RV32IM RISC-V core. A dedicated systolic array accelerator is integrated into the five-stage RISC-V pipeline via a custom matmul instruction, with modifications made to both the GNU RISC-V toolchain and the Spike simulator for software simulation. The Verilog-based hardware architecture incorporates a wrapper for operand control, a counter for profiling, and UART for runtime validation. The complete system was prototyped on a Xilinx Nexys4 DDR FPGA, and performance profiling via waveform analysis and post-implementation timing reports demonstrated a substantial reduction in execution cycles, reducing the effective computational complexity significantly. This work underscores the potential of custom ISA extensions and domain-specific accelerators in advancing the performance of open-source RISC-V-based embedded computing platforms.

ARPITA DEBNATH	Synthesis of fluorescent dyes	Sriram Kanvah Gundimeda	Chemistry	Donor–π–acceptor (D–π–A) conjugated fluorescent dyes are widely explored for their potential in biological imaging and sensing due to their structural tunability and functional versatility. In this study, we focused on the synthesis of a novel D–π–A dye incorporating the carboamide unit of piperine, a natural alkaloid known for its bioactive properties and intrinsic fluorescence. The introduction of the carboamide moiety was intended to enhance structural features such as planarity, conjugation, and solubility, which are desirable for biological applications. A single dye molecule was successfully synthesized , using a two-step reaction pathway involving Suzuki coupling followed by Knoevenagel condensation. The final compound was structurally confirmed using NMR spectroscopy and mass spectrometry. Although photophysical studies were not conducted in the current work, the successful incorporation of the piperine-derived carboamide unit lays the foundation for future exploration of such dyes in bioimaging and sensing.

Arpita Kumawat	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	Large-scale vision-language models like CLIP show excellent performance in aligning images and natural language, yet they fall short in encoding low-level geometric information such as object orientation, viewpoint, and camera parameters. In the first phase of my project, I tested CLIP's ability to retrieve images based on geometric prompts using simple datasets (MNIST and ImageNet subsets). Results showed partial success, particularly with simpler digits and coarse geometric shifts. During my internship, I aimed to improve this by fine-tuning CLIP using LoRA (Low-Rank Adaptation) adapters. I used nerf synthetic and CO3D datasets, generating structured text prompts from intrinsic camera parameters (azimuth, elevation, distance). Only the LoRA modules were trainable, while the rest of CLIP remained frozen. This fine-tuned LoRA-CLIP model significantly improved retrieval accuracy and geometric alignment. Future directions include probing geometric directions in the CLIP space using dense multiscale probing techniques and SliderSpace, as well as binning viewpoint directions into semantic tokens for controllable generation.
Arya Vasudev Mhatre	Product & Web Interface Design of STEM Models/Puzzles	Manish Jain	Creative Learning	In this project we compiled puzzles that encourage computational thinking and introduce Indian history of mathematics to school students. We created fun puzzles along with DIY print versions for accessibility, web versions which allow teachers to create their own puzzles, and instructional videos that explain the puzzles.

Ashutosh Kumar	Generating images of sedimentary heterogeneity for building a machine learning training database	Achyut Mishra	Earth Science	Abstract Sedimentary features at Centimeter-scale such as planar lamination, cross stratification, and ripple marks play a critical role in controlling subsurface fluid flow and rock-fluid interactions, influencing oil and gas production, groundwater movement, hydrogen storage, and carbon sequestration. However, their small scale and complex geometry pose challenges for direct incorporation into reservoir models. This project aimed to develop a machine learning-based approach to capture and model these features for static reservoir characterization. An extensive image dataset comprising over 900 images was compiled, covering key sedimentary structures including planar lamination, planar cross stratification, herringbone cross stratification, hummocky cross stratification, trough cross stratification, and ripple marks. Images were collected from literature and open-access databases, then scaled using ImageJ to convert pixel measurements into real-world units for spatial accuracy. The dataset was organized with detailed annotations, and all images were resized while preserving scale. A convolutional neural network classifier using resnate 18 model was then developed using fast.ai, achieving successful preliminary predictions in distinguishing between structures such as cross bedding and planar bedding. These results demonstrate the potential of combining geological knowledge with machine learning techniques to classify subtle sedimentary features effectively. Future work will focus on expanding the dataset, adding more structures, and improving model accuracy through advanced training and augmentation strategies, ultimately enhancing reservoir modelling workflows.

Ayush Sahu	IoT for machine health monitoring: Development and Prototyping	Madhav Pathak	Electrical Engineering	This project focuses on the development and prototyping of an IoT-based system for machine health monitoring, utilizing the ADXL345 three-axis accelerometer in conjunction with the nRF52 Development Kit (nRF52DK). The ADXL345 provides high-resolution acceleration data, which is crucial for detecting abnormal vibrations and early signs of machine wear. During the integration of the ADXL345 sensor with the nRF52DK board, several technical challenges were encountered. These included issues related to I2C communication stability, difficulties in configuring the sensor's registers, and ensuring reliable real-time data acquisition. For instance, initial attempts at communication sometimes resulted in incomplete data transmission or failure to initialize the sensor correctly, often traced to timing mismatches and incorrect register settings. Additionally, adapting existing libraries and drivers for seamless operation with the Nordic SDK required careful debugging and code modification. Each of these problems was systematically analysed and resolved, leading to a robust and reliable prototype capable of continuous vibration monitoring and data transmission.

Ayush Singh	Aerodynamic analysis of electric distribution towers	Manish Kumar		Snow avalanches pose a serious life and infrastructure threat to mountainous areas. In this study, Computational Fluid Dynamics (CFD) is used to simulate the behavior of snow avalanches and analyze structural mitigation measures. Snow is simulated as a non-Newtonian Bingham plastic fluid to capture its behavior as a granular fluid. A CFD model is validated and applied with ANSYS Fluent 2025 to model snow impact on a vertical wall and validate the results with experiment, for both impact force and timing of impact. A lattice structure is then placed upstream of the wall to evaluate its potential in avalanche energy dissipation. The lattice-structure effectively minimizes the peak force of impact, which indicates decreased structural damage. This method illustrates the capability of combining CFD modeling and structural engineering to create resilient infrastructure in avalanche-prone locations. Ongoing research involves including deformable structures, multiple protective structures, and field-based terrain data for increased applicability.

Ayush Tanwar	Aerodynamic analysis of electric distribution towers	Manish Kumar	Civil Engineering	Abstract This project focuses on the design and development of a portable Universal Testing Machine (UTM) capable of applying loads up to 1 kN for small-scale material testing applications. Traditional UTMs are typically large, stationary, and expensive, limiting their accessibility for educational and field use. To address this gap, a lightweight and modular UTM was conceptualised using aluminium framing, NEMA 23 stepper motors, lead screw mechanisms, and an S-type load cell for accurate load measurement. The entire design was modeled in Autodesk Fusion 360, and structural simulations were conducted to validate load-bearing capacity and ensure safety. Results demonstrated that the structure remains within safe limits under maximum load, with minimal deflection. While the prototype has yet to be fabricated, the validated design offers a promising solution for academic laboratories and prototype testing environments where portability and ease of use are essential.

Bhumil Rangholiya	Development of a relay controller with inputs from WiFi	Dinesh Kumar Sharma	Electrical Engineering	This project presents the development of two IoT-based devices for remote equipment control and environmental monitoring. The project is divided into two independently functioning modules: HubVolt is designed to control the power supply of individual USB ports by enabling or disabling the output of a buck converter through WiFi commands, allowing users to remotely switch connected USB devices on or off via a web dashboard. This is achieved using an ESP32 microcontroller that interprets control commands and toggles the buck module's enable pin through a transistor-based circuit, making it ideal for use in automated labs or test setups. On the other hand, AtmoSync continuously monitors temperature and humidity using a digital sensor (SHT31) and displays the real-time readings on an LED matrix. The devices implement moving average filtering to remove noise introduced by the power source. It periodically syncs the readings with a backend server. This enables reliable environmental monitoring with both local visualization and remote access via a user-friendly web interface.

Bikash Kumar Badatya	Agentic AI based on Graph RAG with applications to quality assurance and transcript analysis	Ravi Hegde	Electrical Engineering	Precise analysis of athletic motion is central to sports analytics, particularly in disciplines where nuanced biomechanical phases directly impact performance outcomes. Traditional analytics techniques rely on manual annotation or laboratory-based instrumentation, which are time-consuming, costly, and lack scalability. Automatic extraction of relevant kinetic variables requires a robust and contextually appropriate temporal segmentation. Considering the specific case of elite javelin throwing, we present a novel unsupervised framework for such a contextually aware segmentation which applies the structured optimal transport (SOT) concept to augment the well-known Attention-based Spatio-Temporal Graph Convolutional Network (ASTGCN). This enables the identification of motion phase transitions without requiring expensive manual labelling. Extensive experiments demonstrate that our approach outperforms state-of-the-art unsupervised methods, achieving 71.02% mean average precision (mAP) and 74.61% F1-score on test data, substantially higher than competing baselines. We also release a new dataset of 211 manually annotated professional javelin throw videos with frame-level annotations, covering key biomechanical phases: approach steps, drive, throw, and recovery.

BISHNU ADHIKARI	Synthesis of fluorescent dyes	Sriram Kanvah Gundimeda	Chemistry	Here, we designed dyes in our lab. Dyes are synthesized by Knoevenagel condensation reaction, Suzuki coupling reaction, and Buchwald-Hartwig cross-coupling reaction. We optimized the reaction conditions by changing the base, solvent, and catalysts. Product formation was confirmed by TLC, and its purification was done by column chromatography and crystallization. The product was characterized by taking NMR and HRMS. Further, we will study photophysical behavior, environmental study, and cell toxicity and biocompatibility in future.
Chavda Haarit Ravindrakumar	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	Novel view synthesis involves generating images of a scene from new viewpoints not present in the original dataset. This requires complex 3d reconstruction and specialised generative models. We are developing a diffusion-based approach for novel view synthesis that does not require retraining. Diffusion models are a very powerful tool for generating images and manipulation. Their latent space is highly structured, and we can leverage this structure to perform various tasks without paying the cost of retraining the model, thereby saving compute and time. We use this pretrained diffusion model to synthesize novel views without training a separate network. We aim to explore the latent space of this model and apply interpolation techniques to generate plausible novel views.

Chinmay Anil Kulkarni	FPGA level implementation of Oscillatory Neural Network (ONN) for constraint Optimization problems such as vertex coloring, digit recognition	Sandip Lashkare	Electronics	Traditional computing systems based on the von Neumann architecture have a separate memory and processing unit, which causes memory bottleneck issues for fast and energy-efficient computing for AI tasks. Neuromorphic computing offers an effective solution to this problem. Neuromorphic computing is inspired by the functioning of brain neurons, which are known for their energy and time efficiency. Oscillatory neural networks (ONNs) also draw inspiration from this neuromorphic computing approach. ONNs overcome this bottleneck by combining memory and computation through phase-based interactions between coupled oscillators, and information is processed through phase synchronisation of these Oscillators. In this project, we implemented a digital ONN on an FPGA for handwritten digit recognition. The system was trained using images of digits '0' and '1' from the MNIST dataset. We used the Hebbian learning rule to train the synaptic weights offline. This work shows the potential of ONNs for low-power, parallel, and scalable edge AI applications.

Chiranjit Nath	Developing specific molecules to study the mechanism of disease oriented proteins	sivapriya kirubakaran	Biological Engineering	This project focused on the synthesis and characterization of small-molecule inhibitors targeting Inosine Monophosphate Dehydrogenase (IMPDH) in Salmonella Typhimurium, a gram-negative bacterium responsible for widespread foodborne illness. IMPDH is a key enzyme in the purine biosynthesis pathway and is essential for bacterial survival and replication, making it an attractive target for antibacterial drug development. Using a rational design strategy, several asymmetric diphenylurea (DPU) derivatives were synthesized from substituted anilines through an isocyanate intermediate generated via triphosgene. Key challenges involved minimizing the formation of symmetrical urea by-products. The synthesized compounds were characterized using techniques such as TLC, column chromatography, mass spectrometry, and NMR spectroscopy. Although partial success was achieved in hydrolyzing ester derivatives to the free acid forms, the overall work demonstrated the complexity of small-molecule synthesis for biological applications. This project contributes to the understanding of structure–activity relationships in drug discovery and paves the way for future optimization of IMPDH inhibitors.

Devansh Lodha	AI/ML for Sustainability	Nipun Batra	Computer Science	While large-scale Vision-Language Models (VLMs) demonstrate remarkable capabilities, their application in high-stakes scientific domains like Earth Observation (EO) is critically impeded by a lack of rigorous, diagnostic evaluation. Standard accuracy metrics fail to quantify how and why models fail, masking critical weaknesses. We address this methodological void by introducing the Skyfall Benchmark Suite, a first-of-its-kind diagnostic framework designed to systematically probe the limits of VLM reasoning in EO. Our contribution is threefold: (1) The Skyfall Atlas, a foundational knowledge graph of Earth's geographic and semantic properties; (2) The Skyfall-Global dataset, a meticulously sampled collection of multi-scale satellite "Scene Packets"; and (3) The novel CASCADE score, a metric that moves beyond binary correctness to reward plausible errors by measuring them along cartographic and semantic axes. Our evaluation of a state-of-the-art VLM using this framework reveals a profound and previously unquantified failure mode: a complete decoupling of the model's strong visual-semantic understanding from its poor geographic grounding. We demonstrate that the model knows "what" it is seeing but not "where" it is, a critical flaw masked by standard evaluations. The complete Skyfall framework is open-sourced to foster a new standard of rigor and transparency, ultimately enabling the development of safer and more reliable AI for critical scientific applications.

Devendra Biswambhar Nath Dubey	Protein expression, purification and crystallizatio n	Vijay Thiruvenkata m	Biological Engineering	In this project, we aimed at recombinant expression, purification, and biochemical analysis of human inosine 5'-monophosphate dehydrogenases (IMPDH) isoforms that are key to guanine nucleotide biosynthesis and represent principal targets of therapy in antimicrobial, antiviral, anticancer, and immunosuppressive approaches. Employing a pET22b(+) expression platform with site-directed inserts for hIMPDH1 and hIMPDH2, we were able to produce high-level, IPTG-inducible protein in E. coli, and then affinity purification using an N-terminal His-tag and Ni-NTA chromatography. Lysis method optimization showed that high-pressure homogenization supported better lysate clarity and protein recovery than sonication. The purified proteins were then quantified and confirmed by SDS-PAGE and spectrophotometric analysis, providing a reliable protocol for isolating both isoforms in active form. In addition, the research tested the biophysical resilience of bacterial strain JC1475 to environmental stresses—salinity, temperature, and ultraviolet radiation—and detailed its limits of survival, situating it as a model for microbial survival under extreme conditions. These combined methodological improvements provide new directions in biochemical, structural, and inhibitor research on human IMPDH, as well as expanding extremophile microbiology knowledge.

DEVYANI IYER	Paper based colorimetric detection of breast cancer	Chinmay Ghoroi	Chemical Engineering	This research will develop a paper-based colourimetric biosensor for the detection of breast cancer. Platinum nanoparticles will be utilized for an enzymatic reaction with a chromogenic substrate. The presence of breast cancer cells will result in a distinct colourimetric response detectable by the biosensor. Conversely, the absence of breast cancer cells will result in no significant colour change. This novel approach will offer a rapid, low-cost, and portable diagnostic tool for breast cancer screening.
Dharam Dev	Development and Optimization of Transition Metal Dichalcogenides (TMDCs) for Wastewater Treatment	Rupak Banerjee	Physics	The rising contamination of water bodies by synthetic dyes and antibiotics presents a significant threat to environmental and public health, demanding the development of efficient remediation technologies. In this study, the photocatalytic potential of $MoSe_2$, a Transition Metal Dichalcogenide (TMDC), was explored for wastewater treatment applications. $MoSe_2$ was synthesized via hydrothermal methods, with and without polyethylene glycol (PEG-400), to investigate the effect of morphology on performance. Characterization through SEM, XRD, and UV-Vis spectroscopy confirmed successful synthesis and revealed that PEG-assisted samples formed well-defined 3D-flower-like structures, enhancing surface area. Calibration studies were conducted using UV-Vis absorption spectra of five organic pollutants (Methylene Blue, Methyl Orange, Rhodamine B, Eosin Blue, and Ofloxacin) over a concentration range of 1–10 ppm. Preliminary dark absorption studies indicated varying degrees of adsorption depending on molecular properties, establishing essential baselines for photocatalytic analysis. The study demonstrates the material's strong light absorption in the visible range and supports its potential for dye and pharmaceutical pollutant degradation, laying groundwork for advanced photocatalytic wastewater treatment solutions.

Dhruv Girish Sadhwani	Exploring molecular mechanisms of FSHD pathology by weighted gene co-expression network analysis	Ashutosh Srivastava	Biological Engineering	FSHD (Facioscapulohumeral Muscular Dystrophy) is an autosomal dominant muscle disorder caused by epigenetic derepression of the DUX4 gene in skeletal muscle. It is characterised by muscle weakness, predominantly affecting muscles in the face, shoulder girdle, and upper arms. Currently, no treatment is available for FSHD since DUX4 is difficult to target, and the molecular changes that follow DUX4 activation, including the gene networks and the biological pathways involved, are still being uncovered. This study was aimed at using the data obtained from bulk RNA seq to generate co-expression networks and infer the disease biology from a network's perspective, wherein a gene is represented as a node and its relationships with one another are denoted by an edge. Our analysis revealed gene clusters that were associated with the FSHD pathology. The results suggested that processes such as extracellular matrix organisation and immune response exhibited strong associations with FSHD pathology. Importantly, we found novel regulatory hub genes such as FKBP10, PLOD3, and COLGAT1 that could be involved in the disease mechanisms. Additionally, we also found previously reported genes such as MMP14 and COL3A1 to be associated with FSHD. The initial findings from this study can be utilised to understand the FSHD-associated molecular mechanisms and find potential drug targets to rescue the pathology.

DHRUV GOEL	Developing an AI-Powered Chatbot for Virtual Reference Service in the Library	Tukaram Kumbar	Library	This research focuses on the development of an AI-powered chatbot tailored for library services, designed to provide 24/7 virtual reference support. Leveraging Python-based tools such as LangChain, LlamaIndex, and Streamlit, the chatbot offers an interactive and intelligent user interface for addressing common library queries. The project includes a comprehensive literature review of natural language processing (NLP) technologies and a survey of over 100 chatbot implementations across global libraries. In addition to the chatbot, a real-time Live Chat system was developed using HTML, CSS, JavaScript, and the WebSocket library. This system enables users to connect with a human librarian during working hours, particularly when chatbot responses are insufficient. Together, these tools aim to enhance the user experience, reduce the workload on library staff, and support the digital transformation of library services, ensuring continued relevance in the era of modern libraries.

Divyansh Sharma	Prosthetic Hand (Voice Controlled)- Prototyping	Tinkerers Lab Madhu Vadali	Mechanical Engineering	This project focuses on the design and development of a low-cost, 3D-printed prosthetic hand controlled via Bluetooth commands. The aim was to create a functional prototype capable of performing basic hand gestures using servo motors using an Arduino-based control system. The prosthetic hand is powered by a portable battery setup, with all components compactly integrated into the mechanical structure. The final prototype demonstrates reliable motion control, wireless operation, and a modular design that can be expanded further. This work serves as a foundation for future enhancements in accessible and low-cost prosthetic solutions.

DIYA ELIZABATH JOSEPH	Mechanisms of distractor supression	Meera M Sunny	Cognitive Science	A central debate in attention capture which refers to involuntary shifts of attention is whether capture is purely stimulus-driven (Theeuwes, 1992) or shaped by the observer's goals (Folk & Remington, 1992). In general, Involuntary is often equated with bottom-up control, and voluntary with top-down. Using paradigms like the Irrelevant Singleton (ISP: random arrangement) and Additional Singleton (ASP: circular display) (Yantis & Egeth, 1999, Theeuwes 1992), prior studies have explored both attentional capture and distractor suppression. However, these paradigms often conflate the two processes. To address this, we adopt a stepwise design inspired by Arita et al. (2012) by combining elements from former established paradigms to better isolate attentional capture and suppression. This approach provides a clearer operationalization of distractor suppression and has implications for understanding attention in populations with attention regulation difficulties, such as ADHD patients.

Freya Kanungo	Condensation heat transfer enhancement through porous media-based condensate removal for space applications	Soumyadip Sett	Mechanical Engineering	Frost formation on surfaces in humid, subzero environments impairs the performance and safety of thermal, energy, and transportation systems by increasing thermal resistance, obstructing irradiance, and adding mechanical loads. Conventional de-icing strategies are energy-intensive and environmentally taxing, motivating passive approaches via surface wettability engineering. This study systematically characterizes condensation and frost dynamics on bare, superhydrophilic (SHPL), and superhydrophobic (SHPB) aluminum surfaces fabricated through controlled etching, boehmitization, and HTMS coating. Experiments were conducted under controlled cooling rates and ambient humidity, with high-speed imaging of droplet and frost behavior. Results demonstrate that SHPB surfaces, owing to their low adhesion and Cassie–Baxter wetting state, significantly delay frost initiation (up to ~54% compared to bare aluminum) and exhibit distinct frost-front propagation rather than uniform coverage. Conversely, SHPL surfaces promote rapid filmwise condensation and uniform frosting. The findings highlight the potential of wettability tuning for passive frost mitigation, laying groundwork for exploring advanced coatings, durability under cyclic icing, and automated image-based analysis in future work.

GOKUL KRISHNAN	Micropaleontology and Paleoclimate of Mid-Miocene Quilon Formation, Kerala Basin	Sonal Khanolkar	Earth Science	This study investigates the Mid-Miocene paleoenvironment and paleoclimate of the Kerala Basin through an integrated analysis of foraminiferal assemblages and clay minerals from the Quilon Formation, sampled at Padappakkara and Pozhikara. The stratigraphic sections comprise fossiliferous marls, glauconitic layers, and laterites, reflecting dynamic shallow marine depositional settings on India's southwest passive margin. Micropaleontological analysis reveals foraminiferal communities dominated by hyaline calcareous forms (e.g., Ammonia, Elphidium, Cibicides), indicative of well-oxygenated, normal marine shelf conditions. Morphogroup data show a shift from rounded to rectilinear and operculinid forms in middle intervals, suggesting transient dysoxic conditions, before returning to rounded dominance. Diversity indices (Fisher's alpha, Shannon's H', and evenness) highlight stable, diverse communities up to PV-3, with a decline in PV-4 implying ecological stress or environmental change. The consistent presence of glauconite indicates slow sedimentation under marine influence, while thin sections reveal Lepidocyclina wackestone, supporting shallow photic-zone carbonate deposition. Together, these results depict a predominantly stable

				shallow marine environment punctuated by minor sea-level and oxygenation shifts, linked to regional responses to global Mid-Miocene climatic oscillations. This work refines the paleoenvironmental and stratigraphic understanding of the Kerala-Konkan Basin during the Neogene.

Goral Mashru	Paper based colorimetric detection of breast cancer	Chinmay Ghoroi	Chemical Engineering	Azelaic Acid is a naturally occurring dicarboxylic acid with known anti-inflammatory, antimicrobial and keratolytic properties. It inhibits the growth of Propionibacterium acnes, an acne causing bacteria, and is effective in treating acne. However, clinical application of Azelaic Acid is limited due to its poor solubility, poor skin penetration and irritation. In this study, we plan to formulate an azelaic acid-loaded nanogel to overcome these challenges. Nanogels, with their hydrophilic characteristics and adjustable properties, present a targeted and skin friendly drug delivery system. Our objective is to develop and characterize a nanogel to enhance the therapeutic efficacy of azelaic acid while maintaining a balance in the skin microbiome.

Harpreet Kour	Sensor fabrication using 3D printing techniques	Maker Bhavan	All Departments	This project presents the design and fabrication of a wearable health-monitoring device using 3D printing techniques which can measure heart rate, SpO_2, sweat and temperature. The system integrates the MAX30102 sensor for measuring heart rate and SpO_2, and the LM35 sensor for temperature monitoring. To ensure compactness and skin compatibility, the prototype is made of flexible TPU and resin. The sensors were interfaced with microcontroller Arduino Nano for real-time data acquisition. This work demonstrates the feasibility of combining additive manufacturing with embedded electronics to develop low-cost, wearable health-monitoring solutions.
Harsh Malodia	Soft Robotics	Madhu Vadali	Mechanical Engineering	This internship project explores the design and simulation of a compressible soft tendon-driven continuum manipulator inspired by natural logarithmic spirals. The objective evolved over time: initially, the focus was on introducing compression in a constant curvature model. Eventually, the scope expanded to the exploration of spiral-based geometries. The project progressed through literature-based analysis, SolidWorks CAD design, MATLAB simulations, spiral fitting using optimization, and physical prototyping.

HARSH VARSHNEY	Developing an application to manage Document Delivery Service	Tukaram Kumbar	Library	This project focused on enhancing and modernizing the Document Delivery System (DDS) used by the IITGN Library to manage article requests and inter-library communications. The system was originally built to streamline the manual workflow of handling document inquiries, which were previously managed through Excel sheets and individual email folders. However, the existing application was outdated in terms of technology and had several inefficiencies and unresolved bugs. The primary objective of this project was to upgrade, improve, and modify the existing DDS application. The enhancements included updating core technologies to their latest stable versions, optimizing system workflows, fixing long-standing bugs, and improving the overall user interface and experience.
HIMADRI MITTAL	Capture of Rare Earth Elements by Polymer Hydrogels	Bhaskar Datta	Biological Engineering	This study explores the adsorption of critical REEs -Eu, Gd,Sm,Dy & Yb-mainly focuses on Sm using eco-friendly hydrogels synthesized from acrylic acid, vinyl sulphonic acid and gum acacia. Structural Characterization performed using FTIR & adsorption efficiency from REE solution was assessed via ICP-OES. The results highlight the potential of these polymer-based hydrogels for sustainable REE recovery.

Himanshu SIngh	AI/ML based climate data downscaling	Vimal Mishra	Civil Engineering	Groundwater sustainability in India faces critical challenges due to intensive agricultural practices, rapid urbanization, and climate variability. This study presents a comprehensive machine learning approach to reconstruct monthly groundwater depth (GWD) time series from incomplete quarterly monitoring data across 4,515 wells on the Indian subcontinent spanning 1996-2021. We employed Extra Trees regression with four distinct modeling approaches: precipitation-only input, combined precipitation and evapotranspiration, comprehensive meteorological and remote sensing integration, and cluster-based integrated modeling. K-means clustering was utilized to address spatial and hydrogeological heterogeneity by partitioning wells into eight distinct clusters based on climatic, physiographic, and hydrogeological characteristics. The cluster-based integrated approach achieved the highest predictive accuracy with a mean RMSE of 1.62 m and R^2 of 0.82. Monthly time series reconstruction was accomplished using Chow-Lin temporal disaggregation, preserving seasonal climate patterns while enhancing temporal resolution. The methodology successfully filled approximately 20% of missing quarterly data and generated continuous monthly records

				essential for sustainable groundwater management and policy formulation in water-stressed regions.

Isha Agrawal	Modeling, Optimization, and Control of Complex Process Systems	Hari Ganesh		Traditional Indian foods like idli are prepared through a series of thermal and biochemical processes that are rarely optimized for energy and resource use. This study models the idli preparation process as a thermal and material system, focusing on steaming—a critical step that determines final quality. A one-dimensional transient heat conduction model was used to simulate vertical heat flow within the idli batter, and energy balances were applied to estimate efficiency. Parameters like specific heat, mass and moisture content, and energy loss were considered. The overall cooking efficiency was found to be around 31%, indicating significant room for improvement in traditional cooking methods. This research offers early insights into how scientific principles can be applied to optimize everyday culinary processes.

Jahanavi Mahajan	Synthesis of fluorescent dyes	Sriram Kanvah Gundimeda	Chemistry	As a part of the Summer Research Internship Program (SRIP) 2025 at the Indian Institute of Technology Gandhinagar, I had the opportunity to work on two projects, under the guidance of Prof. Sriram Kanvah in the field of organic chemistry. These projects aimed to contribute to the development of green synthetic strategies and advanced functional materials. In the first project, I worked on C–X coupling reactions using a pre-synthesized copper-based geopolymer catalyst. Geopolymers have gained significant attention due to its low cost, reduced CO_2 emissions, minimal energy requirements and environmentally friendly nature. The present work is concerned with the application of geopolymer material with incorporated Cu. Cu-supported geopolymers act as efficient and reusable heterogeneous catalysts. Recoverability and reusability of Cu-geopolymer catalysts through simple filtration minimize waste and improve cost-effectiveness. This catalyst, known for its low toxicity, thermal stability, and ease of recovery, was utilized to catalyze cross coupling reactions. My work involved optimizing the reaction conditions, checking the recoverability and reusability of catalyst, monitoring reaction progress, and analyzing the final products using techniques such as thin-layer chromatography (TLC), Mass Spectrometry and NMR. The second project focused on the synthesis of donor–acceptor–donor (D–A–D) type fluorescent dyes. Fluorescent dyes are organic compounds, capable of absorbing light and re-emitting it as visible fluorescence. These molecules were designed for potential applications in sensing and imaging, based on their extended conjugation and intramolecular charge transfer properties. I carried out multi-step organic reactions. The project also included efforts to optimize conditions to improve reaction yields and product stability .Throughout the internship, I gained extensive laboratory experience, particularly

				in organic synthesis, purification (column chromatography, crystallization), and characterization (TLC, Mass Spectroscopy, NMR). More importantly, this experience enhanced my understanding of reaction mechanisms, research planning, and the importance of eco-friendly approaches in modern chemistry.

Janvi Setia	Mapping Large Language Models on FPGAs	Joycee Mekie	Electrical Engineering	This report documents our work with the fpgaConvNet framework, which aims to efficiently map deep learning models onto FPGA hardware. Over the course of the project, we explored the complete flow—from parsing ONNX models to generating deployable hardware designs. We began by working with the front-end parser, simplifying network graphs, applying quantization, and converting model layers into hardware-compatible representations. We also handled cases like fan-out by injecting split layers to maintain valid graph structures. On the optimisation side, we experimented with solver strategies like simulated annealing and greedy methods to balance latency, throughput, and hardware resource usage. These involved modifying folding parameters and partitioning strategies under real-world platform constraints. We also studied how latency is modeled and scheduled, and how the design choices affect performance on FPGAs. Towards the end, we worked on backend deployment by using hardware templates and synthesis scripts to generate bitstreams for platforms like the ZCU104. Overall, this project gave us hands-on experience with the entire hardware-aware model deployment pipeline and deepened our understanding of how machine learning models can be efficiently run on custom FPGA architectures.

Jhanvi Mehta	AI/ML/Sensing for Healthcare	Nipun Batra	Computer Science	Sleep apnea is a widespread yet underdiagnosed condition associated with repeated breathing interruptions during sleep, leading to severe health consequences like cardiovascular issues and chronic fatigue. While Polysomnography (PSG) remains the diagnostic gold standard, its complexity and cost hinder large-scale deployment. This study presents an automated approach to apnea detection using a reduced set of physiological signals—namely respiratory channels and snoring audio—from a dataset of 100 overnight PSG recordings at AIIMS Delhi. Multiple deep learning architectures, including CNNs, LSTMs, ResNets, and Transformers, were evaluated for their effectiveness, with CNN-LSTM and CNN-BiLSTM emerging as the top performers. Notably, incorporating snoring audio consistently improved model performance, indicating its diagnostic relevance. In a further effort to explore sensor-free detection, the study leverages the publicly available PSG-Audio dataset to analyze 10-second snoring segments. A comprehensive feature set of 158 audio descriptors was extracted using TSFEL, along with spectrograms processed by 2D CNNs. These methods enabled accurate classification of apneic vs. normal snores, revealing the potential for snore-only apnea detection. The results validate the use of audio as a standalone modality and underscore the broader potential of contactless, home-based sleep diagnostics. This work marks a step forward in democratizing sleep health assessment through affordable and scalable AI solutions.

Jugal Ishvarbhai Patel	Development of a relay controller with inputs from WiFi	Dinesh Kumar Sharma	Electrical Engineering	This project presents the development of two IoT-based devices for remote equipment control and environmental monitoring. The project is divided into two independently functioning modules: HubVolt is designed to control the power supply of individual USB ports by enabling or disabling the output of a buck converter through WiFi commands, allowing users to remotely switch connected USB devices on or off via a web dashboard. This is achieved using an ESP32 microcontroller that interprets control commands and toggles the buck module's enable pin through a transistor-based circuit, making it ideal for use in automated labs or test setups. On the other hand, AtmoSync continuously monitors temperature and humidity using a digital sensor (SHT31) and displays the real-time readings on an LED matrix. The devices implement moving average filtering to remove noise introduced by the power source. It periodically syncs the readings with a backend server. This enables reliable environmental monitoring with both local visualization and remote access via a user-friendly web interface.

Jyoti Saini	Oxidative Potential and Toxicity of Air Pollutants	Sameer Patel	Chemical and Civil Engineering	Airborne particulate matter (PM), especially PM2.5 and PM10, poses significant health risks due to its ability to penetrate the respiratory system and induce oxidative stress. This study investigates the oxidative potential (OP) of ambient PM collected at IIT Gandhinagar using size-selective air sampling and the dithiothreitol (DTT) assay. The mass concentrations of PM10 and PM2.5 were found to be 70.82 µg/m³ and 37.49 µg/m³ respectively. Through the DTT assay, we evaluated the ability of PM to generate reactive oxygen species (ROS), which are strongly linked to oxidative damage in biological systems. The underlying redox chemistry, primarily involving quinones and transition metals, was also analyzed. Our findings emphasize that mass concentration alone is insufficient to determine toxicity, and highlight the importance of including chemical composition and oxidative potential in air quality assessments. Future studies should incorporate qualitative analyses such as ICP-MS and XPS to better understand the toxicity profile of ambient aerosols.

Kaivalya Shitalbhai Shah	Bi-manual robotic manipulation skills for humanoid robots	Harish P M	Mechanical Engineering	The Half Human project aims to develop a bi-manual humanoid robot capable of performing intelligent manipulation tasks guided by speech and vision. Equipped with 14 Dynamixel motors, an RGB-D camera, and conversational AI, the robot can understand voice commands, perceive its environment, and execute coordinated dual-arm actions. A custom Python SDK and GUI were developed to simplify control and enhance accessibility for learners. By integrating ROS 2, MoveIt 2, and vision-language models, the system demonstrates real-time interaction and decision-making. This project bridges advanced robotics with education, making humanoid technology engaging and approachable for students and researchers alike.

Karan Shrivastava	Designing of ML/AI model to identify signal patterns in real-time	Biswajit Saha	All Departments	Hand gesture recognition has gained prominence in recent years for its potential in creating intuitive and non-intrusive human-computer interaction systems. The motivation behind this project stems from the need for low-cost, real-time gesture recognition solutions that can be deployed using minimal hardware. Our goal was to build a robust gesture recognition system that leverages two flexible strain sensors placed on the wrist and forearm to identify five distinct hand gestures using machine learning models. The project focused on collecting high-quality temporal sensor data, performing signal processing and feature extraction, and training multiple classifiers to identify gestures with high accuracy. A real-time prediction interface was developed using Streamlit, demonstrating the system's practical utility. The outcome showcases the successful deployment of a lightweight, real-time gesture recognition pipeline suitable for wearable devices and HCI applications.
Karthik Chandra Srinayak	Developing Subgrid Scale Models for Wind Flow in Urban Areas Considering Varying Building Heights and Patterns	Sushobhan Sen	Civil Engineering	The project presents the development of subgrid scale models for urban wind flow simulations considering varying building heights and patterns. The research investigates the relationship between urban morphology parameters and drag coefficients through systematic computational fluid dynamics (CFD) analysis using the Lattice Boltzmann Method (LBM) implemented in Palabos and subsequently OpenFOAM. Various building configurations with heights ranging from 2.5–20 m and gaps of 2.5–10 m were analyzed to establish predictive models for the urban canopy parameter F_urb and drag coefficient relationships.

Kashish Bhatt	Designing of ML/AI model to identify signal patterns in real-time	Biswajit Saha	All Departments	This project explores the design and implementation of a real-time machine learning (ML) and artificial intelligence (AI) model to recognize human gait patterns using raw sensor data. The primary objective is distinguishing between normal and atypical gait patterns by extracting and analyzing biomechanical features such as step count, cadence, stride length, and sensor-derived statistical features. A Random Forest classifier trained on these features achieved an accuracy of 97%, demonstrating the viability of sensor-driven, data-centric gait diagnostics. This approach has potential applications in early diagnosis of mobility disorders, rehabilitation tracking, and wearable health monitoring. This report deeply explores the data acquisition techniques, signal processing strategies, feature engineering methodology, and implementation architecture for real-time deployment. Furthermore, the scientific foundations of gait cycle segmentation and its biomechanical relevance are described, along with multiple visual and statistical analyses that support the classifier's robustness and generalization capabilities.

Khushi Kumari	Green chemistry: Photocatalysis by metal free organic dyes	Iti Gupta		Amide bond formation plays a vital role in the synthesis of pharmaceuticals, agrochemicals, and functional materials. In this project, we have explored the Pd(II)dipyrrinato as a photocatalyst, which catalyzed light assisted oxidative amidation of various substituted aromatic aldehydes with pyrrolidine under white light irradiation. The goal was to evaluate the reactivity, efficiency, and scope of this Pd(II)dipyrrinato catalytic system under mild reaction conditions. The reaction proceeds efficiently with ambient oxygen, requiring no additional oxidants. This study contributes toward developing sustainable and scalable methods for C–N bond construction.

Khwaishi Vishal Thakore	Modeling NAND Hole Etching and Oxide-Nitride-Oxide Stack Deposition processes	Nihar Ranjan Mohapatra	Electrical Engineering	This report, "Modeling NAND Characteristics, Hole Etching and Oxide-Nitride-Oxide Stack Deposition processes," details a project to enhance NAND flash memory manufacturing. The study involved simulating device characteristics, including threshold voltage shifts and charge variations. A key focus was High Aspect Ratio (HAR) etching, investigating how species and parameters like flux and angle distribution contribute to defects such as twisting, bowing, and faceting. These analyses are vital for optimizing Oxide-Nitride-Oxide (ONO) stack thickness and refining HAR etching parameters. This report will detail the technical steps involved in the simulation, the results obtained from experimentations, and the challenges encountered during the internship. It will also address recommendations for future work.

Kovid Parmar	Construction for the GeoD Labs portal	Utsav Mannu	All Departments	During the Summer Research Internship Program (SRIP) 2025 at IIT Gandhinagar, I worked on the project titled "Construction of the GeoD Labs Portal" under the mentorship of Prof. Utsav Mannu. The project's primary goal was to design and develop a professional, responsive, and user-friendly website to serve as the official online platform for the GeoD Lab. The portal showcases the lab's vision, research themes, team members, publications, and contact details in a clean and accessible format. Over the two-month internship, I handled all stages of development from gathering requirements and creating design wireframes to coding, testing, deploying, and refining the site. I built the portal using HTML, CSS, and JavaScript, focusing on modularity, responsiveness, and performance optimization. Key challenges included maintaining cross-browser compatibility, ensuring a smooth user experience on all devices, and writing clean, maintainable code. The final website is publicly hosted on GitHub Pages and provides a lasting digital identity for the lab. This project helped me sharpen my technical skills in web development and strengthened my ability to manage and execute a real-world project independently. It also taught me how to convert abstract requirements into tangible outcomes and communicate progress and decisions effectively.

Kshitij Suresh Giri	Prosthetic Hand (Voice Controlled)- Prototyping	Tinkerers Lab Madhu Vadali	Mechanical Engineering	This project focuses on the design and development of a low-cost, 3D-printed prosthetic hand controlled via Bluetooth commands. The aim was to create a functional prototype capable of performing basic hand gestures using servo motors using an Arduino-based control system. The prosthetic hand is powered by a portable battery setup, with all components compactly integrated into the mechanical structure. The final prototype demonstrates reliable motion control, wireless operation, and a modular design that can be expanded further. This work serves as a foundation for future enhancements in accessible and low-cost prosthetic solutions.
Laksh Jain	AI/ML/Sensing for Healthcare	Nipun Batra	Computer Science	Images of different modalities possess unique characteristics that define their utility across various domains. Although Vision-Language Models (VLMs) have demonstrated impressive capabilities in processing RGB images, their understanding of other modalities, particularly thermal imagery, remains underexplored. Thermal imaging plays a pivotal role in applications where conventional RGB imagery is inadequate, such as surveillance, search and rescue, industrial inspection, and medical diagnostics. Existing multi-modal benchmarks (MME, MMBench, SEED-Bench, MMVet) predominantly focus on general visual understanding and fail to address the distinctive characteristics of the modalities they include. This paper introduces ThermEval-B, a comprehensive benchmark designed to evaluate the zero-shot performance of VLMs on thermal imagery, specifically temperature reasoning and interpretation. Our benchmark contains structured evaluation tasks including modality classification, counting humans, temperature reasoning, and temperature estimation across 5000+ thermal visual question answers. To support future

				research, we release a novel open-source dataset, called ThermEval-D, featuring thermal images with pixel-level temperature annotations, a resource scarcely available to the research community. Our findings reveal that leading VLMs, including LLaMA, Qwen-VL, InternVL, and LLaVA, struggle with fundamental thermal concepts despite their ability to distinguish thermal images from RGB imagery. This paper contributes by (1) identifying critical gaps in VLMs' understanding of thermal imagery, (2) providing a structured evaluation framework for thermal-specific reasoning, and (3) offering a novel dataset with precise temperature ground truth. These insights underscore the need for targeted multimodal training approaches that incorporate modality-specific understanding, particularly in domains where thermal imagery is crucial to decision making.

Lawannya Pramod Dakhane	Evaluation of the use of biochar as an additive in concrete	K. Siva Teja Chopperla	Civil Engineering	This study investigates the use of ASB biochar as a sustainable partial replacement for cement and sand in mortar to address the environmental challenges of CO2 emissions and sand scarcity. Mortar mixes with varying biochar percentages and saturation levels (dry, 50%, and 100%) were tested for workability and compressive strength. Results showed that 100% saturated biochar improved flow compared to dry and 50% saturation, while 5–10% replacement levels had similar strength as the control(with 0% biochar). The findings highlight biochar's potential in developing low-carbon, high-performance mortar mixes for sustainable construction.

Maitri Chaudhari	Dam break flow analysis	pranabmohapatra	Civil Engineering	The dam break analysis for Ukai Dam (Gujarat), Dowleswaram Barrage (Andhra Pradesh), and Nagarjuna Sagar Dam (Telangana-Andhra Pradesh) combined geospatial processing and hydraulic modelling to assess flood risks from overtopping failure scenarios. Digital Elevation Models (DEMs) were processed in QGIS to extract terrain data, which was imported into HEC-RAS to build geometric profiles of the dams and downstream channels. Breach parameters such as development time and breach width were defined using empirical equations tailored to each structure's characteristics. Unsteady flow simulations in HEC-RAS generated hydrographs showing discharge variations and depth maps illustrating inundation patterns, enabling detailed evaluation of potential flood extents and risks to downstream areas.
Manas Tripathi	Machine learning approaches for prediction of hydrological extremes	Vimal Mishra	Civil Engineering	This project focuses on improving the accuracy of Ensemble Rainfall Forecasts through real-time bias correction. We developed a hybrid pipeline combining Long Short-Term Memory (LSTM) networks and XG Boost to correct systematic errors in rainfall predictions. The model was trained and evaluated on sub-daily ensemble forecasts over India. Compared to raw forecasts, our approach significantly improved performance, achieving a 0.57 increase in NSE, 32.7% reduction in MAE, and 18% lower PBIAS. The results highlight the potential of combining deep learning and machine learning for operational hydrological forecasting.

Manav Berawala	Sensor fabrication using 3D printing techniques	Maker Bhavan	All Departments	This report presents the design and fabrication of a flexible wearable biosensing patch aimed at real-time, non-invasive monitoring of physiological biomarkers such as glucose, lactate, and heart rate. The patch uses microfluidic channels for sweat transport, enzyme-integrated electrodes for biomarker detection, and PZT sensors for cardiovascular monitoring. Components were embedded within a flexible, skin-compatible housing fabricated using 3D printing techniques. The device is designed to offer a low-cost, scalable solution to bridge the gap in accessible diagnostics, especially in post-COVID-19 decentralized healthcare environments. The project integrates interdisciplinary elements from biotechnology, embedded electronics, materials science, and 3D printing to prototype a functional health-monitoring patch. Various versions were iterated through trial-and-error methods including reverse engineering of existing devices. Key milestones included CAD-based patch design, flexible resin-based microfabrication, electrochemical ink development, enzyme immobilization, and successful heart rate capture through piezoelectric transduction
MANISHA DAS	Asymmetric Organocatalysis	Chandrakumar Appayee	Chemistry	Asymmetric Michael type reaction

MEDHA BANIK	Bioreactor optimization for algal growth	Chinmay Ghoroi	Chemical Engineering	Chlorella vulgaris is a fast-growing microalga known for producing a wide range of useful compounds such as proteins, lipids, carbohydrates, chlorophyll, and carotenoids. These compounds have important applications in areas like biofuels, animal feed, food supplements, cosmetics, and medicine. The nutritional content of C. vulgaris can vary based on growth conditions, with protein levels ranging from 42–58%, lipids from 5–40%, and carbohydrates from 12–55% of its dry weight. Besides its rich composition, C. vulgaris also helps in removing pollutants from wastewater and capturing carbon dioxide from the environment, making it environmentally beneficial. The aim of this project is to design and improve a sustainable and cost-effective biorefinery method for extracting and studying these valuable compounds in a sequential process. This approach supports the full utilization of microalgal biomass for multiple industrial applications.

Meet Janiyani	Augmented Reality for molecular modelling	Kaustubh Rane	Chemical Engineering	Augmented Reality (AR) offers a novel way to interact with complex datasets by blending digital content with the physical environment. This project presents an AR-based Data Visualization system designed to enhance the interpretation and accessibility of multidimensional data. By leveraging AR technology, users can view and interact with 3D plots, such as Probability Density Functions (PDFs), directly in their surroundings using mobile devices. The system is integrated with a FastAPI backend that allows dynamic generation of plots based on user-selected features. Unlike traditional 2D or PDF-based visualizations, this immersive solution provides spatial understanding and intuitive control, making it ideal for educational, analytical, and research purposes. The project showcases the future potential of combining AR with data science to create interactive, engaging, and informative visual experiences

Meet Rakeshkumar Pandya	Industrial wastewater treatment	Chinmay Ghoroi	Chemical Engineering	Rare Earth Elements (REEs) are critical for India's transition towards renewable energy and digital infrastructure. The increasing demand for REE-based permanent magnets in electric vehicles, wind turbines, and electronic devices has created a pressing need for sustainable recycling technologies. This study presents a comprehensive analysis of advanced recovery and processing techniques for REEs, focusing on Hydrogen Processing of Magnetic Scrap (HPMS) technology. The research examines various recycling strategies, including hydrometallurgical, pyrometallurgical, and direct recycling methods, emphasizing the environmentally friendly hydrogen-assisted approach. The HPMS process demonstrates significant potential for recovering NdFeB magnet powders from end-of-life applications, offering a sustainable alternative to conventional extraction methods. This study analyzes the entire value chain from automatic dismantling of magnet-containing products to the production of recycled magnets through sintering, polymer bonding, and metal injection molding techniques. The research aims to contribute to India's circular economy objectives and reduce dependency on REE imports while establishing domestic recycling capabilities. Expected outcomes include optimization of HPMS parameters for Indian conditions.

				development of cost-effective separation techniques, and establishment of design-for-recycling protocols for future applications. Keywords: Rare Earth Elements, NdFeB magnets, Hydrogen Processing, Circular Economy, Sustainable Recycling, Permanent Magnets

Mehak Rajani Nahata	Design Research on Reading of Board Game Rules	Malay Dhamelia	All Departments	This study explores how individuals comprehend board game rules and how their mental models evolve during the early stages of learning a game. We developed a structured methodology combining free listing and concept mapping to capture participants' initial understanding and conceptual organization of game rules. In the Free Listing Activity, participants identified possible actions and their corresponding effects based on the rulebook, followed by reflective questions on reading strategies and areas of uncertainty. This was designed to elicit the breadth and perceived importance of rule elements. In the Concept Mapping Task, participants represented relationships between key concepts, enabling visualization of structural understanding. This approach moves beyond traditional post-reading interviews by emphasizing participant-driven elicitation of knowledge structures. The study outlines the development of these tools and the data collection process, forming the foundation for future analysis of rule comprehension and mental model shifts.

Misti Dharmeshkumar Shah	Machine learning approaches for prediction of hydrological extremes	Vimal Mishra	Civil Engineering	Developing a 5 km downscaled CMIP6 projections using machine learning Mentor: Devesh and Sahil Intern: Misti Shah and Shriansh Mishra BriefRA5-Land Summary Precipitation extremes are projected to intensify more rapidly than mean precipitation under continued greenhouse gas emissions, posing significant challenges for climate impact assessment and adaptation planning. This study aims to develop high-resolution (5 km) downscaled climate projections based on CMIP6 models to better capture regional-scale variability in precipitation extremes. The resulting projections will support improved risk assessments and inform climate-resilient infrastructure and water resource management strategies in vulnerable regions.

Mithil Surya Darisi	Timetable Enhancements	Manoj Gupta	Computer Science	This report summarizes the work carried out during a summer internship at the Indian Institute of Technology Gandhinagar (IITGN) under the supervision of Dr. Manoj Gupta. The internship comprised two projects. The first project focused on automating timetable validation through integration with Google Calendar using its API. The system enabled real-time detection of scheduling conflicts, enforced institutional policies, and provided an accessible user interface, resulting in a functional and user-friendly prototype. The second project was an independent research effort aimed at optimizing the bundled Dijkstra algorithm using two Fibonacci heaps. Despite not achieving performance gains, the project deepened understanding of heap structures and algorithmic trade-offs. Together, the projects provided a balance of practical system development and theoretical exploration, enhancing skills in API integration, algorithm design, and software engineering.

Muskan Mishra	Development of Metal Organic Frameworks	SUPERB MISRA	Materials Science & Engineering	The focus of this internship was studying Metal–Organic Frameworks (MOFs), with an emphasis on HKUST-1. The two major topics were development of, and characterization of MOFs. The work was conducted under the SRIP program at IIT Gandhinagar over the course of 8 weeks, it was a comprehensive blend of theoretical knowledge and laboratory work. During the first 4 weeks, I gained quite a bit of theoretical background through literature review. In the review process, we examined MOFs' structure, properties, applications, limitations, mechanisms of synthesis and characterization. Several sources were referred to for this purpose, including primary sources, literature reviews, and resources as simple as Wikipedia. After understanding the theoretical side of MOFs, we began working in the lab and made three batches of HKUST-1 using three different synthesis conditions. All three synthesis conditions included differences in synthesis parameters such as temperature, pressure, and solvent composition. The characterization of the final materials included Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD) and Energy-Dispersive Xray Spectroscopy (EDX) to examine surface morphology, crystallinity and elemental composition of our samples. Even minor adjustments to preparation parameters could signify major differences in the structural and morphological properties of MOFs. This internship not only deepened the understanding of MOF chemistry but also enhanced practical skills in materials synthesis, characterization, and scientific analysis

NAYANSHI JAIN	DNA Barcoding of Indian Medicinal Plants	Subramanian Sankaranarayanan	Biological Engineering	DNA barcoding relies on small standardized segments of genetic material to recognize different species. This project focused on creating accurate DNA barcodes to identify some chosen Indian medicinal plants, including Avicennia (A. marina, A. of icinalis) and Basella (B. alba, B. rubra). The main goals involved choosing markers, designing primers, extracting DNA performing amplification, sequencing, creating barcodes, and validating phylogenetic relationships.
Neha	Computational Investigations at the Graphene-Aqueous interface	sairam swaroop mallajosyula	Chemistry	This study presents a computational investigation into the geometry optimization of DNA nucleobases—adenine, thymine, cytosine, and guanine—within a graphene-based nanochannel for potential applications in label-free, solid-state DNA sequencing. Leveraging the unique electrical and structural properties of graphene, a confined nanochannel system was constructed using a multilayered graphene configuration with a central vacuum gap to accommodate individual nucleobases. Quantum chemical methods were employed to determine the most stable geometrical configuration of each base, with geometry optimization performed using SIESTA while keeping the graphene layers fixed. The results showed that all nucleobases adopted stable, planar orientations with consistent π–π stacking distances (\~3.34–3.37 Å), indicating strong and reliable interaction with the graphene sheets. These optimized geometries form the foundation for the subsequent electronic transport analysis aimed at identifying the distinct electronic signatures of each nucleobase. This work lays the groundwork for developing highly sensitive, scalable, and efficient graphene-based DNA sequencing technologies as an alternative to traditional biological approaches.

Neil Shah	Aerodynamic analysis of electric distribution towers	Manish Kumar	Civil Engineering	This report presents a comprehensive study on the aerodynamic behavior of utility poles, modeled as circular cylinders, under high wind conditions such as cyclones. The objective is to understand how drag forces vary across different Reynolds numbers and how they contribute to structural failures. A literature review of wind-induced tower failures and flawed pole mechanics established the basis for simulation and analysis. Using ANSYS Fluent, a series of computational fluid dynamics (CFD) simulations were conducted across a wide range of Reynolds numbers by varying cylinder diameters, while maintaining a constant freestream velocity. The results were used to generate and validate the drag coefficient (Cd) versus Reynolds number (Re) curve, revealing expected transitions between laminar and turbulent flow regimes. Contour plots and streamlines were analyzed to visualize separation zones and wake formation. The study concludes with proposed future work involving a more realistic model of two utility poles connected by a wire, where dynamic effects such as flutter and load transfer will be explored. The findings contribute toward designing safer, cyclone-resilient utility infrastructure and serve as a foundation for both CFD and experimental validation in wind tunnel testing.

Nikhil Kumar	development of an Environmental Quality Monitoring System (EQMS)	Sameer Patel		Particulate Matter (PM) pollution poses a significant threat to both public health and the environment, especially fine particles like PM1, PM2.5, and PM10, which can deeply infiltrate the lungs and bloodstream. However, continuous and accurate monitoring of PM levels remains challenging due to the high cost and complexity of commercial sensors. This project aimed to address that gap by developing a low-cost, scalable, and indigenous PM sensing solution. Using a custom-designed 3D-printed chamber, a laser module, and a high-sensitivity light sensor, the prototype captures light scattering caused by airborne particles. These optical readings, along with temperature and humidity data, were mapped to actual PM concentrations using machine learning models. Multiple environmental experiments were conducted using a commercial PMS5003 sensor as a reference. Models such as LightGBM and XGBoost delivered high accuracy for PM2.5 and PM10 predictions, though PM1 accuracy was limited due to hardware sensitivity. In parallel, improvements were made to the EQMServer's backend and frontend infrastructure, including real-time data syncing and UI enhancements for monitoring. The resulting system demonstrates a viable alternative to expensive commercial PM sensors, with reliable performance and real-time capabilities. Looking ahead, improving PM1 accuracy, enabling wireless data transmission, and scaling server support for more sensor nodes are key directions for future work.

Nikhil S	Designing of ML/AI model to identify signal patterns in real-time	Biswajit Saha	All Departments	Surface classification using tactile sensing has emerged as a crucial area for enhancing real-world perception in robotics and embedded systems. This project addresses the need for a low-cost, real-time solution capable of detecting surface types through touch without relying on vision or expensive hardware. Our goal was to develop a compact and deployable surface classification system that leverages resistance-based tactile data to accurately identify various surface types. The project involved collecting real-time resistance data, extracting statistical and signal-based features, and training a Random Forest classifier for surface prediction. A live visualization dashboard was developed using Streamlit, offering real-time confidence scores and predictions. The final system demonstrates reliable surface recognition performance, highlighting its potential for robotics, automation, and context-aware embedded applications.

NIRMALYA DE	Condensation heat transfer enhancement through porous media-based condensate removal for space applications	Soumyadip Sett	Mechanical Engineering	This project explores the implementation of thermoelectric cooling (TEC) using Peltier modules for localized cooling of both air and water. Traditional cooling systems like vapor compression cycles are effective but have notable drawbacks, such as noise, environmental concerns due to refrigerants, and mechanical complexity. In contrast, Peltier modules offer compact, solid-state, and eco-friendly solutions without moving parts. A custom duct-based system was developed where the cold side of a Peltier module interacted directly with flowing air and water. Experiments were conducted in both open-loop and closed-loop configurations using fans and centrifugal pumps to circulate the fluids. The primary aim was to evaluate the cooling effectiveness of the Peltier setup under different electrical inputs (voltage and current) and fluid flow conditions. Results showed that water provided better cooling performance than air due to its higher thermal capacity. The study also identified the limitations posed by ice formation on the Peltier surface, which reduces heat transfer efficiency. The findings support the potential of TECs for small-scale applications such as electronics cooling, medical devices, and remote cooling systems, especially when combined with renewable energy sources like solar power.

Omisha Vaish	Analysing economic relationships using large scale household surveys	Deepak Singhania	HSS	This study explores how rural employment patterns respond during droughts, and how patriarchal norms mediate the gendered labor response. In agrarian economies, environmental shocks such as droughts often disrupt labor allocation. However, the extent to which men and women can respond to such shocks depends not only on economic structure but also on prevailing social norms. Using district-level panel data from CMIE's Consumer Pyramids Household Survey (2014–2019), combined with the Standardized Precipitation Evapotranspiration Index (SPEI) and a Patriarchy Index by James & Singh, this research examines how gendered labor outcomes shift under climatic stress. We focus on rural districts and explore how labor supply differs by gender across varying patriarchal intensities. We find that women's employment is more adversely affected in highly patriarchal regions during droughts, while male employment remains relatively stable. This reveals how gender norms act as structural constraints, limiting women's economic agency during crises.

Paranjay Lokesh Chaudhary	AI/ML/Sensing for Healthcare	Nipun Batra	Computer Science	Touch-based interaction forms the backbone of modern human-computer interfaces, powering everything from smartphones to industrial control systems. Conventional technologies, primarily capacitive touchscreens, are well-optimized for controlled conditions but exhibit vulnerabilities. This project explores a fundamentally different approach: vibrations. When a user taps on a solid surface, mechanical vibrations propagate through the material. By strategically placing accelerometers at the edges of the surface, these vibrations can be captured, processed, and analyzed to infer the location of the tap.
PATEL SANSKAR VIMAL	Design of solar water distill for 20 lit capacity: designing the experimental rig and mass balance/energy balance analysis.	NITIN PADHIYAR	Chemical Engineering	The increasing scarcity of clean drinking water poses a critical challenge, especially in off- grid and arid regions. This project presents a cost-effective and eco-friendly solar water distillation (SWD) system utilizing a double-slope basin design to purify water using only solar energy. The design is aimed at maximizing thermal efficiency while maintaining simplicity and low production cost. The system incorporates an in-depth material selection study, optimizing the basin, glass covers, insulation, and coatings for improved absorption and minimal heat loss. A comprehensive mathematical model was developed, based on energy balance equations for

				the double-slope basin, considering solar input, convective/radiative losses, and internal temperature gradients to dynamically estimate distillate yield. The fabrication was completed in stages, and the system was tested under three con- figurations: • Standard distiller • Black-coated basin • Black coating with external reflectors Further advancement was explored through integration of solar vacuum tubes, nanoparticle- enhanced coatings, and phase change materials (PCMs) to store excess thermal energy and maintain prolonged operation during low-sunlight periods. A hybrid concept was also investigated, combining solar cooker functionality with the SWD unit to increase versatility in rural applications. These enhancements lay the foundation for a next-generation hybrid solar system capable of water purification, cooking, and energy storage marking a step forward in multi-utility renewable solutions.

Pattem Bhanu Prakash	Product & Web Interface Design of STEM Models/Puzzles	Manish Jain	Creative Learning	This project was on the design and development of interactive web interfaces for a wide range of STEM-based puzzles developed by the Center for Creative Learning (CCL), IIT Gandhinagar. With more than 750 STEM models and 50+ puzzles already designed and disseminated to over 1 lakh schools in India, the idea was to make these models easily accessible and engaging using digital platforms. During the internship, I worked on end-to-end development of various web applications for puzzles involving logic puzzles, spatial reasoning problems, map coloring, and image-based tile reconstruction puzzles. In my work, I employed custom solvers, puzzle generators, UI/UX, and print/export facilities with web technologies such as JavaScript and React. Most of these apps were deployed over the web with open access using GitHub. The initiative focuses on creativity, computational thinking, and user experience design in order to enhance STEM learning as interactive, engaging, and scalable.

Pawan Seth	Desing of Al alloys for structural applications	Prafull Pandey	Materials Science & Engineering	This study presents the development of a new cast Al-Fe-based eutectic alloy enhanced with zirconium (Zr) for automotive powertrain applications. The addition of Zr stabilizes $L1_2$-Al_3Zr nano-precipitates, which helps the alloy resist precipitate coarsening and retain mechanical strength during long-term high-temperature exposure (up to 250°C). The Zr-modified alloy, produced by arc melting and chill casting, exhibits finer microstructure and maintains higher hardness and yield strength (261 MPa at 25°C, 160 MPa at 250°C) compared to the Zr-free alloy and also the alloy give a good microstructural stability after exposing for long duration at high temperature. These results indicate the alloy's potential for use in demanding applications requiring thermal and mechanical stability.

PEDDINTE JASMITHA	Dam break flow analysis	pranabmohapatra	Civil Engineering	The dam break analysis for Ukai Dam (Gujarat), Dowleswaram Barrage (Andhra Pradesh), and Nagarjuna Sagar Dam (Telangana-Andhra Pradesh) combined geospatial processing and hydraulic modelling to assess flood risks from overtopping failure scenarios. Digital Elevation Models (DEMs) were processed in QGIS to extract terrain data, which was imported into HEC-RAS to build geometric profiles of the dams and downstream channels. Breach parameters such as development time and breach width were defined using empirical equations tailored to each structure's characteristics. Unsteady flow simulations in HEC-RAS generated hydrographs showing discharge variations and depth maps illustrating inundation patterns, enabling detailed evaluation of potential flood extents and risks to downstream areas.
Pendse Chinmay Sameer	Hybrid Compute In-Memory for ML applications	Joycee Mekie	Electrical Engineering	Digital In-Memory Computing (IMC) aims to re move the bottleneck of Von-Neumann architecture between the processor and the memory, thus reducing the power, area and costs. So, we strive to research and implement an optimised SRAM architecture and reduce the power and area with respect to the earlier optimised FP-ATM NOR gate approach.

Pinki Saini	Plug and Play Tool for Electric Vehicle Safety Enhancement	Pallavi Bharadwaj	Electrical Engineering	Lithium-ion batteries (LIBs) are considered as the heart of Electric Vehicles (EVs), but their performance degrades over time, affecting vehicle safety and performance. Accurately estimating the battery's State of Health (SOH) is crucial for ensuring optimal battery performance, safety, and longevity. However, current SOH estimation methods are often complex, data-intensive, and unsuitable for real-time embedded use. This project proposes a simple, computationally efficient, and battery management system (BMS)-compatible technique for SOH estimation using voltage-time profiles during constant current charging. The method focuses on extracting two key features — time taken to reach 4.0V and the slope between 3.8V–4.0V during constant current charging of the battery, and applies support vector regression (SVR) function to estimate SOH. The results show accurate prediction with minimal error, validating its real-time suitability for embedded BMSsLithium-ion batteries (LIBs) are considered as the heart of Electric Vehicles (EVs), but their performance degrades over time, affecting vehicle safety and performance. Accurately estimating the battery's State of Health (SOH) is crucial for ensuring optimal battery performance, safety, and longevity. However, current SOH estimation methods are often complex, data-intensive, and unsuitable for real-time embedded use. This project proposes a simple, computationally efficient, and battery management system (BMS)-compatible technique for SOH estimation using voltage-time profiles during constant current charging. The method focuses on extracting two key features — time taken to reach 4.0V and the slope between 3.8V–4.0V during constant current charging of the battery, and applies support vector regression (SVR) function to estimate SOH. The results show accurate prediction with minimal error, validating its real-time suitability for embedded BMSsLithium-ion batteries (LIBs) are considered as the heart of

				Electric Vehicles (EVs), but their performance degrades over time, affecting vehicle safety and performance. Accurately estimating the battery's State of Health (SOH) is crucial for ensuring optimal battery performance, safety, and longevity. However, current SOH estimation methods are often complex, data-intensive, and unsuitable for real-time embedded use. This project proposes a simple, computationally efficient, and battery management system (BMS)-compatible technique for SOH estimation using voltage-time profiles during constant current charging. The method focuses on extracting two key features — time taken to reach 4.0V and the slope between 3.8V–4.0V during constant current charging of the battery, and applies support vector regression (SVR) function to estimate SOH. The results show accurate prediction with minimal error, validating its real-time suitability for embedded BMSs

Prajas Kulkarni	Design and prototyping of Electromagnetic Vibration Energy Harvester	Madhav Pathak	Electrical Engineering	Tire Pressure Monitoring Systems (TPMS) are crucial for maintaining optimal tire performance, fuel efficiency, and vehicle safety. Conventional TPMS units rely on disposable batteries, leading to periodic replacement and environmental concerns. This project addresses this challenge by designing and prototyping an electromagnetic vibration energy harvester that can power a TPMS sensor sustainably. The proposed system integrates a spring-mass mechanism, where a magnet oscillates within a solenoid as the tire rotates, converting mechanical vibrations into electrical energy through electromagnetic induction. Mechanical modeling of the magnet's motion was performed using both numerical solutions in MATLAB and dynamic simulations in MSC ADAMS, achieving consistent results with less than 2% error. Electromagnetic behavior was analyzed using COMSOL Multiphysics, demonstrating how variations in coil turns and length affect the induced voltage. Preliminary results show that increasing the number of coil turns significantly boosts the harvested EMF, while coil length influences efficiency. Although some simulation limitations remain due to computational constraints, this study provides a validated framework for developing self-powered TPMS sensors, offering a promising alternative to battery-dependent systems. Future work aims to refine the design, enhance simulation accuracy, and develop an integrated circuit for efficient energy management and storage.
Prakhar Pranav	Filament Prediction of Au-MoS2-Au Memristor Using Machine Learning	Tarun Kumar Agarwal	Electrical Engineering	Various machine / Deep Learning models were tested for filament prediction. Finally the Diffusion models used in point cloud prediction were leveraged to match atomistic position prediction.

Pratham Pranav Shah	DNA Barcoding of Indian Medicinal Plants	Subramanian Sankaranarayanan	Biological Engineering	DNA barcoding (Hebert et al., 2003) is a popular method used for species delimitation(determining whether a group of individuals belong to the same or different species,especially when differentiating on the basis of morphology fails) and other taxonomical and phylogenetic analyses. This is achieved by developing short (generally 500-700 bp)'barcodes' derived from genetic markers such as the universal COI barcode for animals,and others like matK, rbcL, ITS, etc. for plants. The markers are selected based ona variety of criteria including optimum intra- and interspecific divergence, universality,ease of amplification, and most importantly, an optimum rate of mutation and evolution.The standard protocol for barcoding experiments involves DNA extraction and primerdesign, followed by PCR amplification, sequencing, and finally using bioinformatics toolsand softwares to analyze the sequencing results and develop barcodes.Our project focused on using this method to develop barcodes to distinguish betweentwo closely related species belonging to the genus Basella (B.alba and B.rubra),and two closely related species belonging to the genus Avicennia (A.marina andA.officinalis). Both the types of plants mentioned here have medical significance andare known to have a wide range of beneficial properties. Apart from solving the problem of morphology-based differentiation being unreliable in these closely related species, we also aimed to resolve the ongoing taxonomical conflict between B.alba and B.rubra

Priyanshi Shah	Hardware realization of RISC-V	Joycee Mekie	Electrical Engineering	This report outlines the deployment of deep learning models onto FPGA hardware using the fpgaConvNet framework. The project covered parsing ONNX models, graph simplification, quantization, and converting layers into hardware-ready formats. Split layers were introduced to manage fan-out and preserve graph structure. Optimization strategies, including simulated annealing and greedy methods, were explored to balance latency, throughput, and resource usage under platform constraints. Backend deployment involved using hardware templates and synthesis scripts to generate bitstreams for FPGA targets like the ZCU104. The work provided practical experience in mapping convolutional neural network models to custom FPGA architectures.

Priyanshu Tiwari	Analytic Number Theory	Akshaa Vatwani	Mathematics	Sieve methods are powerful tools in analytic number theory that are used to study the distribution of square-free numbers, smooth numbers, and prime numbers. In applied fields of number theory, like Algorithmic Number Theory and Coding Theory, sieve methods have seen numerous applications. In parallel, the study of function fields provides us with an algebraic framework mirroring many results in classical number theory, including the Möbius function. We start with the investigation of the Möbius function over Fq [x], relating it to discriminants, resultants, and the Galois group via the action of the Frobenius automorphism. We establish key properties, including its multiplicative nature and a characterization based on permutation signs. In the second chapter, we analyze the sieve of Eratosthenes and study Φ(x, z) := #{n ≤ x : n is divisible by any prime < z}. We then refine its approximation using Möbius inversion, Rankin's trick, and Mertens' theorem. This approach provides sharper error bounds and a deeper understanding of prime distribution. In the end, we define a general setting of the sieve of Eratosthenes which can be molded into interesting problems, including the study of twin primes.

Rachit Mehta	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	In an era where vehicular threats are becoming increasingly sophisticated, the need for intelligent and automated under-vehicle surveillance systems has never been more critical. Traditional inspection methods—be it handheld mirrors or static CCTV feeds—are often plagued by occlusions, limited viewpoints, and human oversight. Addressing this gap, our project envisions a robust, computer-vision-powered pipeline that transforms raw, distorted fisheye images captured from a multi-camera rig into a unified and interpretable panoramic view of a vehicle's undercarriage. The system begins by correcting the inherent geometric distortions introduced by ultra-wide-angle lenses. Using calibrated distortion models—such as polynomial and ra dial distortion mappings—we undistort the fisheye images to recover perspective views suitable for downstream processing. These corrected images are then passed through a SuperGlue-based feature correspondence framework that employs attention-enhanced graph neural networks to compute dense, high-fidelity keypoint matches across image pairs—outperforming traditional descriptors like SIFT or ORB in low-texture scenarios typical of vehicle undersides.

				Using the correspondences, homography matrices are estimated to perform geometric warping and iterative stitching of the image sequence, ultimately producing a seamless high-resolution mosaic of the vehicle's bottom view. This stitched output is fed into a Variational Autoencoder (VAE)-based anomaly detection framework, which learns the manifold of clean, anomaly-free under-vehicle appearances. At inference time, any devia tion from this learned distribution—such as hidden tools or foreign objects—is captured via heightened reconstruction error, enabling unsupervised anomaly localization. Our system delivers a low-cost, modular, and automated solution for under-vehicle threat detection with minimal human intervention. Designed with scalability in mind, it holds strong potential for deployment in high-security zones such as military checkpoints, border crossings, and critical infrastructure facilities. By fusing classical geometric vision techniques with modern deep learning-based anomaly detection, the project represents a significant advancement toward intelligent, real-time vehicular threat assessment. Keywords: Fisheye Rectification, SuperGlue, Image Stitching, Homography, Variational

				Autoencoder, Object Detection, Under-Vehicle Surveillance
Rahul Ahirwar	Flood management in Narmada river basin	pranabmohapatra	Civil Engineering	Overall, it was a positive experience with a healthy working culture. It was a great opportunity to learn and grow.

Rajat Kumar Thakur	SLMs for specific objectives on resource constrained devices	Anirban Dasgupta	Computer Science	This study investigates the feasibility of employing Small Language Models (SLMs) for in-device Python code generation and log analysis with stringent resource constraints. We fine-tuned two state-of-the-art SLMs, TinyLlama (1.1 B parameters) and StarCoder, on a human-curated scientific corpus (SciDocs, astronomy problems, Wikipedia science articles) and snippets of code from The Stack. For optimal edge suitability, we applied three complementary optimization strategies: structured pruning, sharing of weights between embedding and output layers, and an early-exit policy based on per-layer confidence thresholds. We measure each model's inference efficiency (latency, throughput, memory footprint) and code quality (validity of compilation, success of execution, and a composite Q-Score for accuracy, library usage, and output fidelity). Results show that pruning shortens TinyLlama's latency by approximately half (from ~10 s to ~5.4 s per sample) at the expense of a slight reduction in valid-code rate (43.6 %→39.6 %) and aggregate Q-Score (65.6→62.0). StarCoder, which is most helped by early-exit, exhibits the lowest latency (~2.6 s) and highest throughput (0.356 samples/s), though syntax error rates vary (0–5 errors) across methods. Comparative analysis reveals StarCoder's superior speed and TinyLlama's superior baseline code quality, casting light upon the efficiency-functionality trade-offs. Our findings show judiciously optimized SLMs can enable real-time, offline code generation on edge devices, a privacy-preserving alternative to cloud-based AI. We discuss directions for further enhancing domain-specific accuracy such as fine-tuning for targeted domains and advanced quantization and sketch directions for future research in light, on-device AI.

Rajput Vivek Anarsingh	Design of solar water distill for 20 lit capacity: designing the experimental rig and mass balance/energy balance analysis.	NITIN PADHIYAR	Chemical Engineering	This project addresses the growing scarcity of clean water in off-grid and arid regions by developing a cost-effective, eco-friendly solar water distillation (SWD) system using a double-slope basin design. The system is optimized for thermal efficiency through careful material selection and insulation to reduce heat loss. A dynamic energy balance-based mathematical model was developed to estimate distillate yield, accounting for solar input, thermal losses, and temperature gradients. The system was fabricated and tested under three configurations: Standard distiller Black-coated basin Black coating with external reflectors Further enhancements included integration of vacuum tubes, nanoparticle coatings, and phase change materials (PCMs) for thermal energy storage, along with a hybrid solar cooker-distiller concept to expand utility in rural settings. These innovations pave the way for next-generation hybrid solar systems capable of water purification, cooking, and energy storage.

Rakshit Pandhi	Bi-manual robotic manipulation skills for humanoid robots	Harish P M	Mechanical Engineering	This report summarizes the development and implementation of educational robotics platforms undertaken during the internship. It highlights the creation of challenge-based modules for the Sensing Robot, structured documentation and task design for the Robox Robot, and advanced control exploration with a newly introduced 3D 4-DOF robotic arm. Key contributions include sensor integration, non-visual perception strategies, user-friendly manuals, and the implementation of gravity compensation and orientation control. The work collectively supports hands-on robotics learning and lays a foundation for future classroom deployment.
Reddy Pujitha Reddy	Dam break flow analysis	pranabmohapatra	Civil Engineering	The dam break analysis for Ukai Dam (Gujarat), Dowleswaram Barrage (Andhra Pradesh), and Nagarjuna Sagar Dam (Telangana-Andhra Pradesh) combined geospatial processing and hydraulic modelling to assess flood risks from overtopping failure scenarios. Digital Elevation Models (DEMs) were processed in QGIS to extract terrain data, which was imported into HEC-RAS to build geometric profiles of the dams and downstream channels. Breach parameters such as development time and breach width were defined using empirical equations tailored to each structure’s characteristics. Unsteady flow simulations in HEC-RAS generated hydrographs showing discharge variations and depth maps illustrating inundation patterns,

				enabling detailed evaluation of potential flood extents and risks to downstream areas.

Riddhi Bansal	Activation of Small Molecules by Low-valent Main Group Cmpounds	Priyabrata Ghana	Chemistry	The development of transition metal–main group multiple bonds represents a frontier in modern inorganic and organometallic chemistry, offering novel pathways for small molecule activation and catalysis. In this summer internship project, we focused on the synthesis and characterization of key organometallic precursors and ligands essential for stabilizing such reactive species. The N-heterocyclic carbene ligand SIdipp was synthesized through a multistep procedure involving the preparation of the imidazolinium salt precursor and subsequent deprotonation. Additionally, the cyclopentadienyl lithium reagent (Cp*Li) was prepared by deprotonating pentamethylcyclopentadiene using n-butyllithium. All reactions were performed under inert conditions using Schlenk line and glovebox techniques due to the air- and moisture-sensitive nature of the compounds. The resulting products were purified and characterized using spectroscopic methods such as NMR. The project contributes to the broader aim of exploring new transition metal–main group element multiple bonding motifs by providing essential tools and reagents for their assembly and reactivity studies.

Riddhiman Ganguly	Nanoengineered Surfaces for Antibacterial Applications	Soumyadip Sett	Mechanical Engineering	The need for detecting airborne bacteria is gradually becoming a more pressing necessity with the rise of antibiotic-resistant bacteria populations and for a broader range of variables during air quality mapping. The status quo for atmospheric bacteria detection is the Andersen impactor and the condensation impactor, which use a sieve-like structure to filter aerosols into brackets of diminishing diameters and a rapid temperature change condensation chamber, followed by a particle counter, respectively. The air with bioaerosols passes through several stages of separation or thermal processing and is subsequently either registered by a laser-based particle counter or plated to quantify the number of colony-forming units (CFU)/ per unit volume of air tested. The inherent drawback of these methods is that they require large, heavy instruments and a minimum of 12-14 hours in the agar to express visible bacterial colony growth. As such, using the Andersen or Condensation impactors is a better option for long-drawn, research-oriented tests for air quality. However, their use in smaller spaces on a more urgent schedule, like a small clinic or hospital, becomes very time, space and cost intensive. The need, thus, arises for a rapid, automated test for bacteria in a compact setup. The following proceedings attempt to fabricate a device for that purpose in a compact and affordable package.

Rishika Paryani	Curiosity and Cognition	Jaison Manjaly	HSS	Curiosity, defined as the drive to acquire knowledge even without immediate practical benefits, often arising from a perceived gap in one's understanding. According to researches, individuals tend to learn and memorise better when their curiosity is high, in comparison to materials that evokes low curiosity. Parallelly, research on extrinsic motivation shows memory performance increases when individuals anticipate rewards. However, the research on the interaction of extrinsic rewards and intrinsic motivation ubiquitously points to the detrimental effect on intrinsic motivation of introducing extrinsic reward to activities known to be intrinsically motivating. Murayama and Kuhbandner (2011) studied how monetary reward impacted curiosity and its interaction with curiosity-associated memory performance. Their findings revealed the complex interaction of monetary rewards with curiosity associated memory performance wherein monetary rewards enhanced memory only for low-curiosity trivia questions, but have no impact for enhanced memory performance for high curiosity stimuli. However, one of the major shortcomings of this study being curiosity levels for questions (high and low curiosity question) were recorded from independent sample who were not part of experimental manipulation (rewards present) and hence the results of the interaction of reward and curiosity enhanced memory reported renders a weak conclusion. Therefore, this study aims to bridge the gap and attempt to investigate the role of extrinsic rewards (here points for correct answer used) on experience of curiosity and curiosity associated memory performance. To our best knowledge, this study will be the first direct investigation on the role of extrinsic rewards on experience of curiosity and curiosity enhanced memory. In light of this, the current study aims to directly explore how extrinsic rewards (in the form of points for correct answers) affect the experience of curiosity and the memory enhancement associated with it. The results of this study will possibly inform classroom learning strategies as rewards (in terms of grades) is an

				essential part of learning in classrooms. The objective of the study is to investigate role of extrinsic rewards on curiosity and associated memory. The study will employ a between subject design across 2 phases- testing and surprise memory test. The participants will be subjected to trivia questions, followed by curiosity ratings, confidence ratings and guessing the answer and presentation of correct answer in testing phase. Post 24 hours to testing phase participants will be subjected to surprise memory test. We hypothesize that external rewards will undermine the curiosity (form of intrinsic motivation) and curiosity associated memory enhancement.

Riya	Asymmetric Organocatalysis	Chandrakumar Appayee	Chemistry	The advancement of structurally robust, stereochemically defined organocatalysts is essential for the progression of asymmetric transformations. In this investigation, we present the synthesis of a bicyclic bridgehead methyl-substituted secondary amine catalyst derived from 4-hydroxyproline. The design approach integrates a methyl group at the bridgehead position to augment steric control and enhance enantioselectivity during asymmetric induction. The synthetic pathway encompasses critical transformations such as esterification, α-alkylation, and a Mitsunobu cyclization to construct the bicyclic framework. Characterization was performed utilizing ^{1}H NMR, ^{13}C NMR, IR spectroscopy, and TLC. The synthesized catalyst is anticipated to provide improved selectivity in asymmetric reactions, thereby contributing to the wider applicability of proline-based organocatalysts in environmentally friendly and sustainable synthesis

Ruchi Singh	Brain Computer Interface	Krishna Prasad Miyapuram	Cognitive and Brain Sciences	This study examined a multimodal approach to Brain-Computer Interfaces (BCIs) development by combining Electroencephalography (EEG) and functional Near Infrared Spectroscopy (fNIRS) to improve cognitive state decoding. EEG has excellent temporal resolution but poor spatial resolution; fNIRS has better spatial resolution and motion robustness but has slower hemodynamic responses. We aimed to enhance categorisation performance across cognitive tasks by utilising both modalities. We used a publicly available dataset (Shin et al., 2018) of EEG-fNIRS recordings from 26 participants, performing three tasks: n-back (working memory), Discrimination/Selection Response (inhibition), and Word Generation (language production). We developed task-specific preprocessing, feature extraction, and classification pipelines with ERP, ERD/ERS and hemodynamic features. Our main analysis showed a consistent improvement in performance when using hybrid EEG-fNIRS features compared with unimodal models across tasks. While all tasks were analyzed, hybrid classification was performed primarily for the WG task due to its internally driven nature and known advantages of multimodal data. The hybrid features performed exceptionally well in the word generation task (average classification accuracy was 92%). The results suggest not just the feasibility of hybrid BCIs, but potential for some interesting future avenues of real-time cognitive monitoring and future neuroadaptive interfaces.

RUPESH KUMAR SINGH	Activation of Small Molecules by Low-valent Main Group Cmpounds	Priyabrata Ghana	Chemistry	The urgent need for sustainable and carbon-neutral energy sources has turned attention to ammonia (NH_3) as a hydrogen carrier. Due to its high hydrogen content and established infrastructure for storage and transport, ammonia is emerging as a promising energy vector. This project involved the synthesis of β-diketiminate (NacNac) ligands and their complexation with Cu(I) to form coordination compounds capable of activating ammonia. Through a series of synthetic steps under inert conditions, the ligand was metallated with copper, followed by treatment with acetonitrile and ammonia. The final complexes were analyzed by NMR and cyclic voltammetry to probe their redox behavior and potential in catalytic ammonia oxidation. The work contributes to the growing interest in ligand-stabilized copper complexes for green hydrogen production.

Sachin kumar jha	Transforming passive colloids into active	Chandan Kumar Mishra	Physics	Due to the increasing application of colloids in various fields like medicine, material science, environmental science, etc., it is important to understand the behavior and characteristics of colloidal particles. This project aims to develop a tilting mechanism for a microscope to enable detailed observation of such behavior. The objective was to achieve precise angular positioning of the microscope using a sensor-based control system and to implement the design on a PCB. A DC motor controlled by an ESP32 microcontroller and an L293D driver is used to tilt the microscope. The BNO055 IMU sensor provides real-time pitch angle feedback. PWM signals are adjusted dynamically to control motor speed and direction based on feedback. The results shows smooth and controlled tilting, achieving a precision of less than 1°, supported by the effective braking mechanism as well. However, the targeted precision of less than 0.1° and PCB implementation could not be fully achieved due to time and design limitations. Nonetheless, the current prototype lays a strong foundation for future improvements in accuracy and integration.

Sahil Sudhir Chaudhari	Wearable robotic exoskeleton for human movement assistance	Vineet Vashista	Mechanical Engineering	This study presents a pelvis-mounted passive ankle exoskeleton that uses a mechanical clutch along with springs to store and release mechanical energy during walking. The clutch allows energy stored during swing phase to be released at the end of stance thus, assisting during toe-off. Experimental trials were conducted under two initial cable tensions(0.25 N and 5 N) while keeping the spring configuration constant. VICON motion capture and load cell data confirmed that higher initial tension led to earlier clutch engagement, greater energy storage, and higher assistive force. The device operates without electronics and offers a simple solution for ankle assistance, thus holding a vast potential for future development.

SAI DOLLY HINDOLIYA	Understanding the effect of plasmonic field on the photon emission of individual Quantum dots	Saumyakanti Khatua	Chemistry	Nanoparticles exhibit several unique properties that can be applied to develop chemical and biosensors possessing desirable features like enhanced sensitivity and lower detection limits. The adoption of plasmonic nanomaterials in optical sensors, coupled with the advances in detection techniques, has opened the way for biosensing with single plasmonic particles. Single nanoparticle sensors offer the potential to analyse biochemical interactions at a single-molecule level, thereby allowing us to capture even more information than ensemble measurements. When light hits a thin gold layer placed between two transparent materials, and the angle is just right, the electrons on the gold surface start to vibrate together. This is called Surface Plasmon Resonance (SPR). It happens at a specific angle where the reflected light becomes very dim.The SPR angle changes based on what sticks to the gold layer like proteins, sugars, or DNA. The more molecules that bind, the more the SPR signal shifts. This shift can be used to measure how much of a substance is present on the sensor surface. Gold nanoparticles are highly sensitive to refractive index changes by virtue of their localized surface plasmon resonance (LSPR). Any change of refractive index near these particles causes spectral shift and this property can be used to develop a sensing platform.In this project we mainly worked on the sensing applications by using AuTNP coated u-bent fibre probes.

Sai Sanjay Gawali	Machine Learning for Aerodynamic Analysis of Shock-Boundary Layer Interactions	Vinod	Mechanical Engineering	This study investigates the shock wave–boundary layer interaction (SWBLI) over a flat plate with a protrusion using Reynolds-Averaged Navier–Stokes (RANS)-based CFD simulations. The primary objective is to analyse the impact of various heights and widths of protrusion on wall heat transfer rate under supersonic flow conditions (Mach 4.5). Simulations were performed using ANSYS Fluent with the SST k–ω turbulence model and validated against existing literature. Results show two distinct shock waves—one from a step and another from the protrusion—causing significant variations in pressure, temperature, and flow structure. A strong negative linear correlation was observed between the heat transfer rate and both protrusion height and width. An interpolation model based on simulation data achieved a maximum error of just 0.46%, indicating high predictive accuracy within a defined geometric range. Mesh independence was confirmed, and simulation results aligned well with published data, confirming the reliability of the model. This research provides a model to determine the heat transfer rate through a surface without any simulation, but only within the bounds of the model.

Saiee Mankame	Multilinguali sm and Cognition	Jooyoung Kim	HSS	This pilot study explores the real-time processing of metaphorical versus literal sentences in Marathi, a morphologically rich and syntactically head-final Indo-Aryan language. Grounded in the framework of Conceptual Metaphor Theory and inspired by Grady's primary metaphors, the study investigates whether figurative expressions incur greater cognitive effort than their literal counterparts. Forty pairs of matched sentences (literal and metaphorical) were developed by altering a single prime word while preserving syntactic and lexical structure. Each participant viewed only one sentence from each pair in a randomized, between-items design. Eye movements were recorded using a Tobii Pro eye-tracker, with Areas of Interest (AOIs) defined over the prime word, the full sentence, and the background. Metrics such as time to first fixation, fixation duration, fixation count, and total visit duration were extracted to assess processing load. Five native Marathi speakers participated in the study. Descriptive analysis revealed that metaphorical sentences elicited slightly longer fixation durations, more regressions, and higher visit times compared to literal sentences, especially over the prime and sentence AOIs. Heatmaps supported this trend by showing denser and more revisited gaze patterns for metaphorical items. While the effect was modest and varied by participant, the data suggest that even conventional metaphors demand additional processing in Marathi. These findings contribute cross-linguistic evidence to ongoing debates in psycholinguistics regarding metaphor processing and highlight the importance of extending cognitive linguistic research to underrepresented languages.

Samin Hasan	Gravitational -Wave astronomy with space based deci-Hz band detectors	Anand Sengupta	Physics	The detection of gravitational waves (GWs) from binary black hole (BBH) mergers has revolutionized observational astrophysics. With the proposed next-generation space-based detectors like GWSat and ongoing improvements in ground-based observatories such as LIGO and Virgo, a multi-band analysis of BBH signals becomes possible. This report presents a multi-band parameter estimation study for a catalog of ”golden binaries” by combining the inspiral portion observed in space with the merger-ringdown signals observed on Earth. We simulate detector-frame gravitational wave signals and inject them into Gaussian noise with zero mean and unit variance, shaped by the detectors’ design noise power spectral densities. Source parameters are then recovered using Bayesian inference. We place particular emphasis on ensuring cross-band consistency of the mass and spin of the final black hole formed after merger. We evaluate the performance of IMR models in different frequency regimes, and identify possible biases in the joint analyses.

Samridhi Raj Sinha	Building Indic Benchmarks	Mayank Singh	Computer Science & Engineering	The rapid advancement of Large Language Models (LLMs) has intensified the need for evaluation frameworks that address the requirements of linguistically diverse regions, such as India, and go beyond English-centric benchmarks. We introduce EKA-EVAL, a unified evaluation framework that integrates over 35+ benchmarks (including 10 Indic benchmarks) across nine major evaluation categories. The Framework provides broader coverage than existing Indian language evaluation tools, offering 11 core capabilities through a modular architecture, seamless integration with Hugging Face and proprietary models,and plug-and-play usability. As the first endto-end suite for scalable, multilingual LLM benchmarking, the framework combines extensive benchmarks, modular workflows, and dedicated support for low-resource Indian languages to enable inclusive assessment of LLM capabilities across diverse domains. We conducted extensive comparisons against five existing baselines, demonstrating that EKA-EVAL achieves the highest participant ratings the highest participant ratings in four out of five categories.

sarvesh prajapati	Electrochemical Experiments for Science Education	Manish Jain	Creative Learning	This project presents a multidisciplinary exploration of chemistry and sustainability through three major experimental themes: natural dye extraction and application, copper electrodeposition, and water electrolysis. Using plant-based materials such as turmeric, red cabbage, beetroot, and jamun, we developed natural pH indicators and applied them in textile dyeing, stencil printing, and eco-art techniques like anthotype and cyanotype. The second phase focused on the electrochemical growth of copper dendrites under varied electrode geometries, voltages, and electrolytic setups, with fractal dimensions calculated to analyze pattern complexity. Finally, electrolysis of a NaCl solution using a Hoffman apparatus demonstrated gas evolution, pH variation, and the formation of sodium hypochlorite, with practical implications in water treatment. Together, these experiments integrate hands-on science, environmental awareness, and creativity, promoting experiential learning and highlighting the relevance of chemistry in real-world contexts.

Satvik Desai	Aerodynamic analysis of electric distribution towers	Manish Kumar	Manish Kumar	This project focuses on the design and development of a portable Universal Testing Machine (UTM) capable of applying loads up to 1 kN for small-scale material testing applications. Traditional UTMs are typically large, stationary, and expensive, limiting their accessibility for educational and field use. To address this gap, a lightweight and modular UTM was conceptualized using aluminium framing, NEMA 23 stepper motors, lead screw mechanisms, and an S-type load cell for accurate load measurement. The entire design was modeled in Autodesk Fusion 360, and structural simulations were conducted to validate load-bearing capacity and ensure safety. Results demonstrated that the structure remains within safe limits under maximum load, with minimal deflection. While the prototype has yet to be fabricated, the validated design offers a promising solution for academic laboratories and prototype testing environments where portability and ease of use are essential.

Sayuj Gupta	AI/ML based climate data downscaling	Vimal Mishra	Civil Engineering	Accurate, timely, and actionable flood forecasting has potential for reducing flood risk but remains challenging due to uncertainty in meteorological forecasts, poor hydrological observations, and increasing forecast errors with lead time. While Long Short-Term Memory (LSTM) models have surpassed conventional hydrological forecasting models, they often struggle to capture the timing and magnitude of extreme floods due to long-range dependencies and static feature importance. Here, we propose a sequential LSTM with Multi-Head Attention (SeqLSTM-MHA) to improve 1-3 day ahead flood forecasts, explicitly using historical hydrometeorological and upstream hydrological observations. SeqLSTM-MHA attained NSE of 0.70-0.90 for water level and 0.65-0.80 for streamflow, outperforming traditional LSTMs, decision tree-based models, and multiple linear regression by more than 30%. The model shows strong skill in forecasting extremes, with NSE exceeding 0.6, and accurately captures over 75% of peak magnitudes. Our findings demonstrate the potential of attention-based LSTM for operational flood forecasting, particularly for high-impact events.

SEENIVASAN V	Mechanisms of distractor supression	Meera M Sunny	Cognitive Science	This project presents an experimental approach to investigate the role of attentional mechanisms in visual search using the Flicker Singleton Paradigm. The primary aim is to examine how the presence of a unique singleton distractor influences reaction time and accuracy in detecting target stimuli. The experiment was developed using MATLAB with Psychtoolbox, and it records participant responses in a controlled environment. Data from this experiment will be used to explore attentional shifts, saliency-based visual processing, and cognitive workload. The findings are expected to contribute to understanding how visual attention operates under conflicting stimulus conditions and can support future research in cognitive neuroscience and AI modeling of attention systems.

Shah Dhruv GovindKumar	Capture of Rare Earth Elements by Polymer Hydrogels	Bhaskar Datta	Biological Engineering	This research investigates the adsorption behavior of rare earth elements (REEs)—specifically europium (Eu), gadolinium (Gd), samarium (Sm), dysprosium (Dy), and ytterbium (Yb) with most of the work done on Europium(Eu). Environmentally friendly hydrogels were synthesized using acrylic acid, vinyl sulphonic acid, gum acacia as a natural crosslinker, Ammonium per Sulphate as a Initiator, EGDMA and water . The structural properties of the synthesized hydrogels were characterized using Fourier-transform infrared spectroscopy (FTIR), while the adsorption efficiency was evaluated through Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The findings demonstrate the promising potential of these biopolymer-based hydrogels in the sustainable recovery of REEs from aqueous solutions.
SHAH RUDDHI PINTUBHAI	AI/ML for Sustainability	Nipun Batra	Computer Science	This project tracks the adoption of cleaner brick kiln technologies, such as Zigzag, using satellite imagery from 2016 to 2025. By combining computer vision with model-assisted detection, we pinpoint the year of establishment or transition for each kiln. The study focuses on non-attainment cities like Delhi to analyze compliance trends. It offers a scalable, remote sensing, computer vision–based approach to monitor environmental policy impact on industrial practices.

Shah Tirth	Hardware-Software Co-design of AI hardware accelerator	Joycee Mekie	Electrical Engineering	Matrix multiplication is a core computational prim- itive in signal processing, scientific computing, and machine learning, yet its inherent O(n3) complexity makes it a major performance bottleneck on sequential processors. This report presents a hardware-accelerated implementation of matrix multi- plication through a custom instruction extension to the RV32IM RISC-V core. A dedicated systolic array accelerator is integrated into the five-stage RISC-V pipeline via a custom matmul instruction, with modifications made to both the GNU RISC-V toolchain and the Spike simulator for software simulation. The Verilog-based hardware architecture incorporates a wrapper for operand control, a counter for profiling, and UART for runtime validation. The complete system was prototyped on a Xilinx Nexys4 DDR FPGA, and performance profiling via waveform analysis and post-implementation timing reports demonstrated a substantial reduction in execution cycles, reducing the effective computational complexity significantly. This work underscores the potential of custom ISA extensions and domain-specific accelerators in advancing the performance of open-source

				RISC-V-based embedded computing platforms.

SHALINI DAS	Condensation heat transfer enhancement through porous media-based condensate removal for space applications	Soumyadip Sett	Mechanical Engineering	Efficient pesticide deposition on plant foliage is critical for sustainable agriculture but is often hindered by the hydrophobicity of the epicuticular wax layer and mechanical compliance of leaf surfaces. This study explores the impact dynamics of water droplets on synthetic superhydrophobic PTFE substrates engineered to mimic the surface properties and flexibility of young plant leaves. Experiments were conducted across a range of Weber numbers and inclination angles, with both rigid and flexible surfaces, using high-speed imaging and quantitative image analysis. Key parameters such as spreading diameter, contact time, surface deflection, and sliding distance were extracted. Results demonstrate that flexible substrates absorb a portion of the droplet's kinetic energy, leading to reduced spreading and increased rebound likelihood. Inclined surfaces further modulate droplet behaviour through altered normal and tangential force components. Comparative analysis reveals that both flexibility and inclination significantly influence droplet retention. These findings have direct implications for optimising precision spraying systems in agriculture, highlighting the need for adaptive, angle- and stiffness-responsive nozzle technologies to reduce pesticide wastage and environmental contamination.

Shardul Rakesh Junagade	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	This project explores the concept of generative anagrams, perceptual illusions where a single image transforms into multiple coherent meaningful images under orthogonal linear transformations such as flips, rotations, pixel permutations, or jigsaw rearrangements. Building on this idea, my work explores multi-object visual anagrams using MultiDiffusion, which allows region-specific prompting and transformation control. I also investigated audio anagrams by applying the same algorithm in the spectrogram domain using audio diffusion models like AudioLDM. Preliminary groundwork has been laid for extending the idea to 3D and video-based anagrams to create multi-view illusions that evolve across space and time. This generalisation of perceptual illusions showcases the surprising versatility of off-the-shelf diffusion models. It opens up new possibilities in generative art and multi-view synthesis, all without requiring re-training the diffusion models.

Sharma Kanhaiya Vijay	Asymmetric Organocatalysis	Chandrakumar Appayee	Chemistry	Organocatalysis is considered the third pillar of asymmetric catalysis, alongside enzyme and metal catalysis. Pyrrolidine-based secondary amine catalysts have been widely applied in the synthesis of various drugs and natural products due to their ability to induce high stereoselectivity. Although organocatalysts are metal-free and align with the principles of green chemistry in many aspects, a key limitation remains: the requirement for high catalytic loading, often due to catalyst degradation under reaction conditions. In this work, we focus on the development of a bicyclic pyrrolidine-based secondary amine catalyst designed to improve catalyst robustness and efficiency. Our aim is to reduce catalyst loading while maintaining high reactivity and enantioselectivity, thereby making the process more sustainable and in closer alignment with green chemistry principles
Shihora Vansh Bhaveshkumar	Modelling of the chemo-thermo-mechanical response of structural battery composites	Harini Subramanian	Mechanical Engineering	During the internship i developed numerical framework using Finite Difference method for solving PDEs like Heat-conduction equation and diffusion equation in 2 Dimensions and derive equation for one-way coupling between stress induced due to heat-conduction and diffusion

Shiv Nitinkumar Patel	Development of an AI-based surrogate model for isotropic and orthotropic slabs	Sushobhan Sen	Civil Engineering	◦ Predicted temperature change and Stress Ratio using time-series data with temporal, spatial, and weather features. ◦ Built ARIMA, SARIMA, SARIMAX, and NeuralProphet models to capture trends, seasonality, and external factors. ◦ Developed ANN, RNN, and LSTM models with tailored feature engineering, achieving high prediction accuracy. ◦ Ensured robustness by testing on diverse locations and addressing scaling, sequence design, and tuning challenges.
Shivam Swami	Designing Efficient Organic Solar Cells with Machine Learning and Genetic Algorithms	Anirban Mondal	Chemistry	This project investigates the structural properties of amorphous LiKSiPON (Lithium Potassium Silicon Phosphorus Oxynitride) ionic glasses using ab initio molecular dynamics simulations. By doping the Li_2PO_2N base structure with potassium and silicon, and applying annealing and quenching protocols, the study evaluates medium-range ordering and pair distribution functions across different stoichiometries. Results reveal key insights into the atomic-scale structure and ordering, especially the influence of potassium on the glass network. The findings provide a foundational understanding for optimizing solid-state electrolytes in energy storage applications.

SHIVANG SHARMA	Makerbot 2.0	Maker Bhavan	All Departments	This report shows the software development work I did for MakerBot 2.0, a smart robotic assistant built for the Maker Bhawan at IIT Gandhinagar during my SRIP 2025 internship. MakerBot 2.0 is different from regular voice assistants because it can see people, listen to them, and move its head to look at them while talking. The bot uses computer vision to detect and track faces, and when it sees someone it knows, it greets them by name without waiting for a wake word. If it doesn't recognize the person, it listens for a wake word first. The system runs on a RAG-based hybrid chatbot architecture with Google's Gemini LLM, uses dlib for face recognition, and GTTS for speech. Everything runs on a Raspberry Pi 5. The bot's head moves using servo motors that get real-time position data from face tracking through an Arduino interface, making it feel more alive and engaged. I also built a custom user interface using CustomTkinter for a 5-inch display that shows the bot's status, conversation history, and speaking animations. MakerBot 2.0 combines AI, robotics, and natural language processing to create a system that acts more like a human assistant, and this work could be expanded for use in smart classrooms, information kiosks, and lab automation

SHIVANGI SINGH	Understanding the effect of plasmonic field on the photon emission of individual Quantum dots	Saumyakanti Khatua	Chemistry	This work provides a comparative investigation of CsPbBr3 quantum dots prepared through two different methods: hot injection under inert atmospheres and open-air ligand-assisted reprecipitation (LARP). The prepared quantum dots were characterized for their morphology, photoluminescence, colloidal stability and degradation behavior. Hot injection produced uniform, highly luminescent nanocubes with improved crystallinity and long-term stability. The open-air method, on the other hand, gave heterogeneous shapes, low luminescence and rapid photodegradation under UV. For stability issue resolution, ligand exchange with 4-mercaptobenzoic acid was used and greatly improved retention of fluorescence and aqueous dispersibility. The work emphasizes the central importance of synthesis conditions and surface chemistry in controlling quantum dot functionality for prospective optoelectronic and bio-related purposes.
Shivansh Shukla	Machine learning approaches for prediction of hydrological extremes	Vimal Mishra	Civil Engineering	This project focuses on improving the accuracy of Ensemble Rainfall Forecasts through real-time bias correction. We developed a hybrid pipeline combining Long Short-Term Memory (LSTM) networks and XGBoost to correct systematic errors in rainfall predictions. The model was trained and evaluated on sub-daily ensemble forecasts over India. Compared to raw forecasts, our approach significantly improved performance, achieving a 0.57 increase in NSE, 32.7% reduction in MAE, and 18% lower PBIAS. The results highlight the potential of combining deep learning and machine learning for operational hydrological forecasting.

Shreyansh Bharat Shete	Quantum Carnot Engine - Work and Heat Statistics	B. Prasanna Venkatesh	Physics	In this work, we study heat and work statistics in quantum thermodynamics using the formalism of quantum jump trajectories and the two-point measurement (TPM) scheme. We begin by outlining the stochastic thermodynamic quantities such as work, heat, and entropy production for continuously monitored quantum systems. We then focus on the dynamics of a driven two-level system (TLS) under both zero and finite temperature environments, implemented using the QuTiP library. Particular attention is given to the decomposition of work into driving and measurement contributions. We also explore a linear ramp driving protocol where the TLS undergoes an isothermal transformation. We aim to compare these finite-time results to an idealized quantum Carnot engine cycle, illustrating how our trajectory-level thermodynamics connects with established thermodynamic cycles.

SHRIANSH MISHRA	AI/ML based climate data downscaling	Vimal Mishra	Civil Engineering	This report presents the development and evaluation of a high-resolution climate projection framework for the Tapi Basin, Central India, leveraging deep learning-based statistical downscaling and advanced bias correction techniques. State-of-the-art global climate models (CMIP6 GCMs) operate at coarse spatial resolutions, limiting their utility for regional risk assessment and climate adaptation planning. To address this, we implemented a hybrid methodology combining a Residual-in-Residual Dense Block UNet (RRDB-UNet) deep convolutional neural network for super-resolution downscaling and a trend-preserving, multi-stage bias correction pipeline (Quantile Delta Mapping, tail extrapolation, and Gaussian copula reordering). Historical daily precipitation, maximum, and minimum temperature data (1981–2014) from IMD were used to train and validate the model, while CMIP6 model outputs provided the basis for future scenario projections. The trained system produced daily 5 km projections of precipitation and temperature for 2015–2100 under both low-emission (SSP1-2.6) and high-emission (SSP5-8.5) scenarios. Evaluation against independent observations demonstrates that the downscaling framework substantially improves spatial detail, accurately reproduces local climate variability, and reduces systematic biases—particularly for temperature extremes. Future projections reveal starkly contrasting outcomes between emission scenarios, with SSP5-8.5 indicating nearly double the monsoon rainfall and much larger increases in heat extremes by the late 21st century. The resulting high-resolution, bias-corrected projections enable robust, locally-relevant climate risk assessment and inform adaptation planning for water resource management, infrastructure, and agriculture in the region. The methods and results are extensible to other

				regions and provide a replicable approach for next-generation climate impact studies.

Shriyansh Kumar	Effect of non-isothermal aging on the precipitation kinetics of Mg-Si Al based alloy	Amit Arora	Materials Science & Engineering	This research, undertaken as part of the Summer Research Internship Program (SRIP) at the Indian Institute of Technology Gandhinagar, focuses on investigating the precipitation hardening behavior of AA6082 aluminum alloy through controlled solution treatment and artificial aging. The study examines the influence of solution treatment durations (2, 6, 24 and 48 hours at 565°C) and subsequent aging at 140°C, 160°C, and 180°C for durations ranging from 2 to 24 hours on the hardness evolution of the alloy. A comprehensive literature review highlights that strengthening in Al-Mg-Si alloys is primarily attributed to the formation of coherent β'' (Mg-Si) precipitates, which impart peak hardness, whereas subsequent coarsening and transformation into semi-coherent β and incoherent Mg_2Si phases during overaging result in reduced mechanical performance. To date, all 2-hour and 6-hour solution-treated specimens have been fully polished and prepared, with aging cycles completed, along with taking the hardness data. Solution treatment for the 48-hour batch has also been completed, with aging initiated for the first subset. The final phase of this project will involve microhardness testing, detailed data analysis, and the generation of aging curves to compare precipitation kinetics across temperatures and treatment conditions. These results will be utilized to identify optimal processing parameters for maximizing both peak hardness and thermal stability in AA6082 alloy.

SHRUTIKA MANISH YEWALE	Evaluation of the use of biochar as an additive in concrete	K. Siva Teja Chopperla	Civil Engineering	This study investigates the use of ASB biochar as a sustainable partial replacement for cement and sand in mortar to address the environmental challenges of CO2 emissions and sand scarcity. Mortar mixes with varying biochar percentages and saturation levels (dry, 50%, and 100%) were tested for workability and compressive strength. Results showed that 100% saturated biochar improved flow compared to dry and 50% saturation, while 5–10% replacement levels had similar strength as the control(with 0% biochar). The findings highlight biochar's potential in developing low-carbon, high-performance mortar mixes for sustainable construction.

Shubh Asati	Hybrid Compute In-Memory for ML applications	Joycee Mekie	Electrical Engineering	In-memory computing (CIM) is a way to overcome issues like energy consumption and delay due to data travelling between memory and processor. This is especially useful in case of data-intensive applications, like modern neural networks. SRAM-based CIM architectures are known for their high power efficiency and compatibility with standard CMOS processes. However, their on-chip capacity is limited to mb-kb levels, possessing a significant challenge for large data applications. Resistive RAM (RRAM) is a two-terminal non-volatile memory device, and if it has a high on/off resistance ratio, it offers a substantially higher storage density compared to SRAM. However, RRAM-CIM architectures often suffer from high energy losses due to factors like DC power consumption. Here comes the idea of a hybrid kind of architecture that could leverage the energy efficiency of SRAM and utilize more space by using RRAMs as storage units. Along with this, the project also looks into compute in-memory using Memristor Ratioed Logic (MRL). MRL consumes less space and reduced dynamic power usage as compared to CMOS logic.
Shubh Jain	FastenStation	Tinkerers Lab Madhu Vadali	Mechanical Engineering	In this project, I tried to build a bolt sorting machine for their metric sizes and lengths using their mechanical properties as their differentiator.

SHUBHAM AGRAWAL	Paper based colorimetric detection of breast cancer	Chinmay Ghoroi	Chemical Engineering	Hydrogels have garnered significant attention in biomedical applications owing to their biocompatibility, high water content, and tunable mechanical properties. This study focuses on developing a gelatin-based hydrogel crosslinked using a THPC-Tris chemistry to improve its mechanical robustness for biomedical applications. The gelation process, mechanical stability, and swelling behavior were studied in detail. This report highlights the experimental procedures, results, and relevance of the formulated hydrogel in the context of drug delivery and wound healing applications.
Shubham Saini	Investigation of the use of industrial-waste based SCMs in concrete	K. Siva Teja Chopperla	Civil Engineering	This study includes the use of nanomaterials in the concrete to enhance the concrete's hardened and soft properties. Different techniques were used to analyze the properties of concrete. Scanning electron microscope images were taken to analyze the pore filling property of the nanomaterials. Flow table tests were conducted to measure the workability of the concrete. Compressive strength tests were conducted at 7 and 28 days to measure the effect of the nanomaterial and early strength of the concrete. This also includes the study toward the reduction of cement in concrete to reduce emissions $CO2$ effectively, which leads to more sustainable construction.

Sia Hetal Jariwala	Mapping Large Language Models on FPGAs	Joycee Mekie	Electrical Engineering	Recent advances in large language models (LLMs) have shown promising potential for automating tasks across various domains. This research explores the applicability of open-source LLMs for hardware description language (HDL) tasks, focusing on the generation of Verilog modules. We benchmark three open-source models—Qwen2.5 (14B), Gemma2 (9B), and LLaMA3 (8B)—against a closed-source baseline, DeepSeek-6.7B, across 33 Verilog design tasks. Our evaluation includes zero-shot, few-shot, and chain-of-thought prompting, as well as experiments with multiple quantization formats and fine-tuning strategies (SFT and QLoRA). Results indicate that open-source models, when properly tuned, can achieve high synthesizability and approach the reliability of proprietary alternatives. We also explore automation of testbench and SystemVerilog Assertions (SVA) generation, with correctness verification planned as future work. This study demonstrates the viability of democratizing Electronic Design Automation (EDA) using accessible generative AI.

SK MAHAMMAD ABDULLAH	UAV-mountable compact methane sensing systems for greenhouse gas monitoring	Arup Lal Chakraborty	Electrical Engineering	The goal of this project is to use FPGA technology to design and implement a Digital Lock-In Amplifier (LIA) for methane gas sensing applications. The basic concept is based on phase-sensitive detection, which multiplies a noisy analog input signal by internally generated sine and cosine reference signals before passing it through low-pass filters to extract magnitude and phase information. The LIA designs were developed and compared using two hardware platforms: Red Pitaya STEMlab 125-14 and NEXYS 4 DDR. Using UART-based data transmission to a PC for validation, the NEXYS board successfully generated and demodulated 1f and 2f signals. Despite having integrated ADC/DACs, the Red Pitaya platform experienced network communication issues, but it still holds promise for future enhancements with GUI-based control. FIR filter coefficient optimization for precise low-pass filtering and the use of an ADC sampling clock for reference signal generation are essential design elements. Overall, the FPGA-based LIA exhibits promise for extracting high-frequency, low-noise signals, with room for additional automation and integration.

Soham Ashish Gaonkar	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	This project explores a pipeline for 3D scene reconstruction using a single 360° equirectangular (ERP) image, such as one captured by a GoPro or Ricoh Theta camera. Traditional 3D reconstruction techniques require multiple images or active depth sensors like LiDAR, which are often costly or impractical. In contrast, this work investigates a monocular approach leveraging spherical geometry and recent advances in inverse rendering and neural scene representations. The pipeline begins with depth estimation from an ERP image using MonoDepth360, followed by conversion to a 3D point cloud. Novel perspectives are synthesized by projecting the sparse 3D structure onto multiple views, and inpainting is applied to recover occluded regions. These images and poses are then used to train a 3D Gaussian Splatting (3DGS) model for high-quality view synthesis. Additionally, a Physics-Informed Inverse Rendering (PhyIR) model was implemented from scratch to recover intrinsic scene properties such as albedo, normals, and shading. The combination of physical modeling and learning-based splatting allows for realistic scene reconstruction, relighting, and potential applications in virtual tours or editing. This work demonstrates an end-to-end pipeline from a single panoramic image to photorealistic 3D representations and outlines future directions in inverse rendering and scene editing.

Sohini Bose	Nanoengineered Surfaces for Antibacterial Applications	Soumyadip Sett	Mechanical Engineering	Urinary tract infections (UTIs) are among the most common nosocomial infections, frequently associated with indwelling catheter use. To combat catheter-associated urinary tract infections (CAUTIs), this study explores the green synthesis and application of curcumin-doped silicon dioxide (SiO_2) nanoparticles as a coating material for catheter tubes. Curcumin, a yellow bioactive component of Indian spice turmeric, is known to have a wide spectrum of biological applications. Curcumin, a natural component of the rhizome of turmeric (Curcuma longa), has recently attracted the attention of researchers due to its unique ability to work through so many pathways with its astonishing antioxidant, antiinflammatory, anticarcinogenic, chemopreventive, antiangeogenic, antidiabetic, antiviral and antibacterial properties making it a potential candidate for curing almost every known disease. In recent years, several research groups have focused to explore the potent applications of curcumin with the aid of modern nanotechnology and Nanoparticles. The coated catheter tubes were tested for antibacterial activity against Escherichia coli key UTIcausing pathogens. Fourier-transform infrared spectroscopy (FTIR) confirmed successful doping of curcumin onto the SiO_2 matrix. Minimum Inhibitory Concentration (MIC) and zone of inhibition tests further validated the effectiveness of the coatings. This study highlights a promising biofunctional surface for catheters to reduce infection rates without inducing antimicrobial resistance.

Sounak Biswas	Developing specific molecules to study the mechanism of disease oriented proteins	sivapriya kirubakaran	Chemistry	The DNA Damage Response (DDR) pathway, crucial for genomic integrity, offers a promising target for cancer therapy, particularly through inhibition of ATR (Ataxia Telangiectasia and Rad3-related protein), a key kinase in managing replication stress. This project focuses on the design, synthesis, and evaluation of novel pyrimido-pyrimidine-based small-molecule ATR inhibitors using an integrated in silico and experimental approach. Several compounds were designed by modifying the aldehydic group of the nicotinamide scaffold, followed by computational screening through molecular docking and molecular dynamics (MD) simulations. Among the designed molecules, compound 5A demonstrated a superior docking score (-10.436 kJ/mol) and stable binding interactions compared to known ATR inhibitors like Ceralasertib and BAY1895344. The top-performing candidates (5A–5D) were synthesized via multi-step reactions including amide coupling, cyclization, Suzuki coupling, and characterized using NMR and LCMS. The synthesized compounds exhibited structural integrity and purity, confirming successful synthesis. This study highlights compound 5A as a promising ATR inhibitor and lays the groundwork for further biological evaluation. Additionally, the internship provided valuable hands-on experience in rational drug design, synthetic organic chemistry, and computational modeling relevant to cancer drug discovery.

Sourabh	Development of an AI-based surrogate model for isotropic and orthotropic slabs	Sushobhan Sen	Civil Engineering	This research focuses on developing an artificial intelligence (AI)-based surrogate model for predicting flexural and shear stresses in isotropic and orthotropic structural slabs. Traditional finite element analysis (FEA) methods, while accurate, are computationally expensive and time-consuming, particularly when applied to large-scale parametric studies. To overcome these limitations, this project integrates open-source tools—Gmsh for geometry generation and CalculiX for FEA—to create a scalable and license-free simulation pipeline. A comprehensive dataset comprising approximately 1500+ simulation cases will be generated, covering a broad range of slab geometries, material properties, and loading conditions. The extracted stress outputs from these simulations will serve as ground truth for training machine learning models that map input parameters to stress responses. The resulting surrogate model will offer rapid and reliable stress predictions, enabling efficient structural design, sensitivity analysis, and real-time decision-making. By capturing both isotropic and orthotropic material behaviors, the model holds significant potential for modern applications in civil engineering. This research aims to bridge the gap between high-fidelity simulation accuracy and the practical need for fast, intelligent structural analysis tools.

Suyog Latake	Designing 2D Materials based membranes for fuel cell applications	Gopinadhan Kalon	Physics	Fuel cells rely on special membranes that can efficiently transport ions while staying chemically selective and mechanically strong. In this project, we set out to develop innovative membranes using two dimensional materials, specifically a combination of piperazine (Pip), trimesoyl chloride (TMC), and vermiculite (VMT). After experimenting with various concentrations, we discovered that a formulation with 0.4 wt% piperazine and 11 ml of vermiculite(in 50ml soultion) performed the best. It offered excellent salt rejection and water permeability-key traits for effective membrane function in fuel cells. On a parallel track, we looked to nature for inspiration. We explored Turing patterns, those intricate, naturally occurring structures that arise from reaction-diffusion processes as a blueprint for designing membrane microstructures. Using AI, we generated more than 16,000+ unique Turing pattern images and trained a machine learning model to reverse-engineer the parameters that created each pattern. This gives us the ability to start from a desired pattern and work backwards to its design recipe, a powerful tool for customizing membrane structures computationally. By combining hands-on experimentation with data driven design, this project takes a step toward creating the next generation of high-performance membranes for fuel cells, blending materials science with AI powered creativity.

Swastika Rupal	Neural correlates of Tactile Perception - behavioral & computational approach	Leslee Lazar	HSS	This study examined how people learn categories using vibrotactile stimuli that vary in amplitude and frequency. Participants completed a tactile categorization task across four training blocks and one test block, with category structures designed to be either rule-based (RB) or information-integration (II). Using a linear mixed-effects model, we found that only the II-P condition showed consistent learning over time. RB-A showed delayed improvement, while RB-F showed no significant gains. Decision-bound modeling revealed a strong bias toward integrative strategies across all conditions, even when rule-based strategies would have been optimal. These findings suggest that amplitude and frequency are perceptually fused in the tactile domain, limiting the effectiveness of rule-based learning and challenging assumptions of flexible attention in the COVIS model.

Tania Choudhary	Data Converters for Analog Compute In memory architectures	Joycee Mekie	Electrical Engineering	Physically Unclonable Functions (PUFs) offer a hardware-based solution for secure key generation and device authentication by exploiting inherent process variations in integrated circuits. Ensuring the quality and randomness of PUF outputs is critical for reliable cryptographic applications. This work employs the NIST Special Publications 800-90B and 800-22 to rigorously evaluate the entropy and statistical properties of PUF-generated bitstreams. NIST SP 800-90B is used to estimate the min-entropy and assess the unpredictability of the PUF responses, while NIST SP 800-22 provides a suite of statistical randomness tests to evaluate their uniformity and independence. The combined methodology delivers a comprehensive validation framework for determining the suitability of PUFs in cryptographic systems. Results indicate that the tested PUF instances exhibit high entropy and pass key statistical tests, demonstrating their potential as reliable sources of randomness for secure hardware applications.
Tanish Wanve	Designing of ML/AI model to identify signal patterns in real-time	Biswajit Saha	All Departments	As a Research Intern at IIT Gandhinagar under Prof. Biswajit Saha (May–July 2025), I worked on real-time visualization of continuous foot pressure sensor data. The project involved designing a live data acquisition and visualization pipeline for an insole embedded with 8 pressure sensors. I developed real-time 2D heatmaps over a custom foot-shaped outline, interactive 3D bar plots, and time-series graphs using Python libraries such as Matplotlib, Plotly, and Pandas. The system enables intuitive monitoring of foot pressure distribution and transitions during standing and walking activities.

Tanisha Rathi	Developing specific molecules to study the mechanism of disease oriented proteins	sivapriya kirubakaran	Biological Engineering	This internship involved hands-on research in the field of organic synthesis, carried out under the supervision of Professor Sivapriya. Over the course of eight weeks, I worked on the synthesis and characterization of various chemical derivatives using advanced laboratory techniques such as NMR and HRMS spectroscopy. The primary goal was to optimize synthetic routes and analyze structural outcomes. This experience allowed me to apply theoretical knowledge from coursework to real-world chemical research, improving both my technical skills and scientific thinking. The findings and learnings from this internship contribute to a deeper understanding of the research process, and will serve as a strong foundation for future academic and research pursuits.

Tanishi Das	Condensation heat transfer enhancement through porous media-based condensate removal for space applications	Soumyadip Sett	Mechanical Engineering	The transition from dropwise to filmwise condensation negatively impacts the heat transfer in heat exchangers, necessitating condensate removal for enhanced performance. Condensate removal via droplet jumping is an extensively studied phenomenon, particularly coalescence induced jumping. It is however, limited by the size of the coalescing droplets. Here, by introducing two surfaces of contrasting wettabilities, we induce the droplet to jump solely due to the difference in the surface energies of the two surfaces. Droplets are observed to jump from a superhydrophobic surface to a superhydrophilic surface. Our study validates the existence of this wettability driven jumping phenomenon and characterizes the range of sizes and the distances jumped by the droplets.

Tanuj Sharma	Biohydrogen from biomass	Chinmay Ghoroi	Chemical Engineering	With the growing demand for lithium-ion batteries (LIBs) in electric vehicles and portable electronics, effective and sustainable recycling of spent batteries has become a critical challenge. This project explores an environmentally friendly hydrometallurgical process for the selective recovery of valuable metals, lithium (Li), cobalt (Co), and nickel (Ni), from spent LIBs. The procedure begins with the safe discharging of batteries using a sodium chloride solution, followed by manual dismantling to isolate the cathode material. Leaching is performed using sulfuric acid (H_2SO_4) and hydrogen peroxide (H_2O_2), dissolving the target metals into solution. Subsequent steps involve pH-controlled precipitation to remove impurities such as iron (Fe), copper (Cu), aluminium (Al), and manganese (Mn), followed by selective extraction of Co using D2EHPA, precipitation of Ni with dimethylglyoxime (DMG), and recovery of Li as lithium carbonate (Li_2CO_3) using sodium carbonate. The process achieved high metal recovery efficiencies, 95.16% for Co, 98.44% for Ni, and 97.74% for Li. This work demonstrates a safe, efficient, and low-energy recycling strategy that offers a cleaner alternative to traditional pyrometallurgical methods.

Tarun Kumar	Stochastc template bank for gravitational wave searches using low-discrepancy sequences	Anand Sengupta	Physics	The first direct detection of gravitational waves in 2015 opened a new era in astron omy. As detectors such as Advanced LIGO become more sensitive—especially at low frequencies—the parameter space for compact binary coalescence searches expands, re quiring increasingly dense template banks for matched filtering. Traditional stochastic placement using uniform random sampling may leave gaps in coverage, reducing detection efficiency. In this report, we explore the use of low-discrepancy sequences, specifically the Halton sequence, to construct more uniformly distributed stochastic template banks. This approach offers improved coverage and may enhance the efficiency of future gravitational wave searches involving millions of templates.

Thorat Avdut Vijay	Aerodynamic analysis of electric distribution towers	Manish Kumar	Civil Engineering	This project focuses on the design and development of a portable Universal Testing Machine (UTM) capable of applying loads up to 1 kN for small-scale material testing applications. Traditional UTMs are typically large, stationary, and expensive, limiting their accessibility for educational and field use. To address this gap, a lightweight and modular UTM was conceptualized using aluminium framing, NEMA 23 stepper motors, lead screw mechanisms, and an S-type load cell for accurate load measurement. The entire design was modeled in Autodesk Fusion 360, and structural simulations were conducted to validate load-bearing capacity and ensure safety. Results demonstrated that the structure remains within safe limits under maximum load, with minimal deflection. While the prototype has yet to be fabricated, the validated design offers a promising solution for academic laboratories and prototype testing environments where portability and ease of use are essential.

Tusi Bhardwaj	Development and assessment of nutrient dense food products	Bhaskar Datta	Biological Engineering	The present study focuses on the development of Himalayan Burfi, a nutrient-dense, culturally rooted food product designed to meet the elevated physiological and nutritional demands encountered in high-altitude environments. Targeted primarily for military personnel and mountaineers, the formulation incorporates traditional Indian millets, nuts, seeds, ghee ,jaggery to deliver a balanced profile of carbohydrates, protein, fats, iron, calcium, omega-3 fatty acids, and vitamin E. The product was developed considering the challenges of appetite suppression, increased energy expenditure, and oxidative stress under cold and hypoxic conditions. The nutritional value of the formulation was assessed using the Indian Food Composition Tables (IFCT 2017), and the results were evaluated against the ICMR-NIN Recommended Dietary Allowances (RDA 2020). A semi-trained panel conducted sensory evaluation using a 9-point hedonic scale to assess acceptability. While chemical analysis is ongoing, initial findings support the product's potential as a functional and palatable high-altitude food supplement. The study demonstrates a practical approach to designing regionally appropriate, shelf-stable food products that align with physiological needs in extreme environments.

				Keywords: High-altitude nutrition, functional food, nutrient-dense, military ration, Himalayan Burfi, Indian food systems, cold environments, omega-3, vitamin E, millet-based formulation, sensory evaluation
Umang Shikarvar	AI/ML for Sustainability	Nipun Batra	Computer Science	Brick kilns are widespread across India and major contributors to air pollution. Traditional object detection models like YOLO and Faster R-CNN perform well within a region but suffer a 20–30% performance drop when applied elsewhere due to domain shifts. We propose combining unpaired image-to-image translation (via CycleGAN) with active learning on Faster R-CNN. Using just 10% labelled data from the target region, our method achieves a 13.8% increase in mAP@50, demonstrating strong gains in cross-region generalisation.

Urja Srivastava	Generative AI for Computer Vision Applications	Shanmuganathan Raman	Computer Science	This project explores the application of Hyperbolic Graph Neural Networks (HGNNs) to the problem of 3D point cloud classification. Traditional Graph Neural Networks often rely on Euclidean geometry, which can limit their ability to capture hierarchical structures. HGNNs, particularly those using the Poincare ball model, provide an opportunity to embed and learn from non-Euclidean structures more naturally. Over the course of the SRIP internship, extensive experimentation was conducted on the ModelNet10 dataset using both PointNet and HGNN-based models. The project involved data preprocessing, graph construction, literature review, model debugging, and training multiple architectural variants of HGNNs. This report presents the findings, challenges, and conclusions from the internship work.

Vani Kumar	Board Game Analysis (and some re-design)	Jyothi Krishnan	Creative Learning	This report presents the design and mathematical modeling of Rahee, a network-based strategic board game themed on travel through India. Although intended as an educational game for children, the report focuses on the formal graph-theoretic structure and simulation-driven analysis underpinning the game's mechanics. The Indian map was represented as a weighted, undirected graph with cities as nodes and travel routes as edges, enabling the use of classical algorithms to assess connectivity and feasibility. A Monte Carlo simulation framework was developed to model player behavior under budget and dice-based movement constraints, incorporating a heuristic softmax-based simulated annealing strategy to mimic decision-making. The report details the construction of the game graph, a custom path visualization interface, application of network metrics, and simulation experiments evaluating path efficiency, goal completion, and memory collection. The resulting data was used to assess game balance and propose improvements in character design, goal assignment, and network structure.

Vedant Ghuge	Characterization of Power Management Integrated Circuits (PMICs)	Madhav Pathak	Electrical Engineering	This project focused on the systematic characterization of Low Dropout Regulators (LDOs) and Bandgap Reference (BGR) circuits, both critical components in Power Management Integrated Circuits (PMICs). A modular and automated testbench was developed using high-precision instruments, including Keithley 2450 Source Measure Units (SMUs), Keysight DSOs, and arbitrary waveform generators. Communication with these instruments was established through both SCPI (via PyVISA) and TSP (Lua-based) scripting for seamless automation and data acquisition. Characterization tests covered key parameters such as line regulation, load regulation, quiescent current, load transient response, and Power Supply Rejection Ratio (PSRR). The methodology involved synchronized dual-SMU operation, waveform triggering techniques, and precision data logging. For PSRR and transient analysis, waveform generation and oscilloscope control were integrated with real-time measurement scripts in Python. In addition to LDO testing, temperature-dependent behavior of BGR circuits was analyzed using Peltier modules and RTD sensors, enabling accurate tracking of voltage drift with temperature. The project also included the design and fabrication of a custom PCB for LDO testing after damage to the evaluation module. Overall, the project enhanced practical knowledge of analog circuit behavior, precision instrumentation, and test automation, laying a strong foundation for future work in analog and power IC characterization.

Veera Belapurkar	Multilingualism and Cognition	Jooyoung Kim	HSS	The present work attempts to investigate the cognitive consequences of trilingualism in Marathi-English-Hindi speakers using the framework of code-switching and inhibitory control. Using psycholinguistic concepts and neuroimaging results as the foundation, the study analyzes how multilinguals control conflicting linguistic systems and executive functions, which include attention and cognitive flexibility. A trilingual Stroop task will be constructed to assess interference and switch costs between languages, and it is expected to show stronger control requirements when switching from a less dominant to a dominant language. The results are expected to be consistent with the Inhibitory Control Model, which posits that habitual language switching enhances cognitive control. Being sensitive to the cultural specificity of Indian language use, the research also criticizes the shortcomings of standard tools such as the LEAP-Q and suggests an India-specific questionnaire that addresses simultaneous language acquisition, script preference, and sociolinguistic identity. More generally, the project combines cognitive and sociolinguistic approaches to yield a context-sensitive understanding of multilingual cognition in the Indian context.

Vikranth Mallru	Soft Robotics	Madhu Vadali	Mechanical Engineering	A SOFA-based validation framework enables rigorous quantitative assessment of tendon-driven continuum robots (TDCRs) designed for biomimetic, agile manipulation in constrained environments. High-fidelity simulation protocols integrate clean tetrahedral mesh generation, realistic cable routing via 3D control points, and region-of-interest (ROI) tracking to precisely measure backbone deformation during actuation. Both standard constant-curvature and trunk-inspired variable-curvature prototypes are evaluated, with shape fidelity confirmed by circle or spiral fitting and low quantitative errors across all driven states. Workspace analyses map each robot's achievable volume, while interactive visualizations facilitate detailed inspection of backbone trajectories and fitting quality. This comprehensive approach demonstrates robust agreement between simulated and intended kinematics, establishing a repeatable, scalable foundation for validating future soft robot concepts and translating digital prototypes into practical, high-performance continuum robots.

Yash Choudhary	Fiber Bragg grating (FBG)-based microphone	Arup Lal Chakraborty	Electrical Engineering	This project focuses on the development of a UAV-based water vapor measurement system that integrates custom hardware and AI-powered software for retrieving gas concentrations. The hardware component involved reverse engineering, circuit design, and assembly of a system comprising temperature and current ICs, a photodiode, a laser diode mount, sensors, a Raspberry Pi, GPS, 4G communication modules, and power regulation units. A functional prototype was constructed and tested, ensuring correct voltage levels, continuity, and stable operation. The software component aimed to automate gas concentration estimation with high accuracy and speed using simulated spectra from the HITRAN database and deep learning models. Literature surveys on state-of-the-art neural network filtering techniques informed the approach, emphasizing noise suppression, low-SNR robustness, and real-time processing. Simulated Wavelength Modulation Spectroscopy (WMS) signals were generated using HITRAN parameters, Voigt profile modeling, and Fourier analysis to obtain 1f components. Multiple algorithmic approaches—including grid search, fine-tuning, and Python-based automation—were explored to optimize retrieval accuracy, though computational and integration challenges persisted. The work demonstrates an interdisciplinary integration of optics, embedded systems, and AI for environmental sensing, with potential applications in compact, real-time UAV-based atmospheric monitoring systems.

Yashvardhan Soni	Aerodynamic analysis of electric distribution towers	Manish Kumar	Civil Engineering	This project investigates the aerodynamic behavior of utility poles under strong wind conditions using computational fluid dynamics (CFD). Motivated by large-scale pole failures during cyclones, a simplified pole was modeled as a smooth circular cylinder and simulated in ANSYS Fluent across a wide Reynolds number range. The study aimed to validate the standard drag coefficient vs. Reynolds number curve by conducting parametric simulations using laminar and turbulent flow models. A mesh convergence study ensured numerical accuracy, and results were compared with experimental data from literature. While the simulation captured the expected flow trends, the computed drag coefficients were consistently lower than experimental values. The project establishes a foundation for future analysis of more complex pole–wire systems and contributes toward the design of wind-resilient infrastructure in disaster-prone regions.

Yohan K	Soft Robotics	Madhu Vadali	Mechanical Engineering	A ROS 2 based framework has been developed for task planning that enables robots to follow natural human instructions by integrating predefined action modules with perception capabilities. The framework interprets high-level commands such as ”go to the car” or ”count objects while going to the car” and automatically generates corresponding Python code that operates at the controller level. This allows the robot to perform complex tasks by seamlessly combining navigation, perception, and action execution. The system effectively bridges the gap between human language and robotic control, providing a scalable and modular approach for intelligent task automation.

Yug Desai	Bi-manual robotic manipulation skills for humanoid robots	Harish P M	Mechanical Engineering	This project presents a robust and efficient pipeline for real-time 6D pose estimation of objects through dynamic 3D reconstruction. Using synchronized RGB-D and IMU data from the Intel RealSense D435i camera, the system enables on-the-fly reconstruction of novel objects with minimal manual intervention. The pipeline integrates advanced deep learning models—XMem for temporal segmentation and LoFTR for feature matching—within the BundleSDF framework to generate accurate 3D object meshes. For pose estimation, the FoundationPose model is employed with CUDA acceleration to ensure high computational performance and low latency. The solution successfully achieves real-time tracking and accurate pose estimation, with built-in visualization tools for verification. Key challenges, including masking inconsistencies and GPU limitations, were addressed through user-guided segmentation improvements and computational optimizations. This work lays a strong foundation for scalable, deployable 6D pose estimation systems with applications in robotics, augmented reality, and automated inspection.

Yuvraj Motiramani	Agentic AI based on Graph RAG with applications to quality assurance and transcript analysis	Ravi Hegde	Electrical Engineering	In India, handwritten forms remain prevalent across healthcare, education, and public sector workflows, often captured via mobile phones and plagued by noise and distortions. Digitizing these documents is critical but hindered by the cost and complexity of manual annotation and large-scale model deployment. This research proposes an automated pipeline that leverages large language models (LLMs) to generate synthetic datasets for training lightweight visual document understanding (VDU) models tailored to fixed-layout forms. Given a few sample forms, LLMs generate plausible field-value pairs, which are rendered into synthetic handwritten images using handwriting synthesis and visual augmentation techniques. These image-text pairs are then used to fine-tune compact models specialized for specific form layouts. Compared to a baseline using purely visual augmentation (56.7% field-extraction accuracy), our LLM-augmented approach achieves 61.3% accuracy on real-world data while eliminating manual data annotation, supporting rapid model development, and optimizing for low-resource environments. The study evaluates synthetic data quality and VDU performance, demonstrating the viability of LLM-assisted synthetic data generation for scalable, efficient form digitization.