Joint PhD Program **Personal Statement** **Mihir Anand**

Growing up and attending school in a village area of India, with very minimal resources and, exposure to science and technology was a relatively rare, and much appreciated, opportunity. I come from a state in India (Bihar) where the education system suffers from limited resources and social issues. Although I initially thought being from a rural area was a disadvantage for an aspiring scientist, I now realize that the lack of an external influence allowed me to independently cultivate and foster a set of scientific interests that is uniquely true to my character and passions. During my secondary education, I loved to take part in different science and mathematics Olympiads, for which I won many prizes. I also qualified for National merit Cum Means scholarship (NMMS) and became a scholar to support my senior secondary education. After my high school, I aimed to clear India's toughest exam (also in the list of world's toughest examination); the JEE-Advanced. After clearing the examination being among the top 1 percent of 1.5 million students, I was fortunate to gain admission into the Indian Institute of Technology [IIT(BHU),Varanasi].

I got admitted in the school of Biochemical Engineering as a part of chemical engineering with Integrated dual degree, a 5 years course combining both bachelors in Technology and Masters of Technology in biochemical engineering and biotechnology. After enrolling into this course I learned much more about biological engineering and its importance in the world. I still remember the first lecture by Prof. Kundu, here he explained that biotechnology is the future, a developing field moving quickly relative to previously established engineering fields. This greatly excited me and deepened my interests in engineering biological systems.

The summer after my second year, I began an internship in Prof. Arun Goyal's lab at IIT, Guwahati in the Department of Biosciences and Bioengineering. In Goyal's lab, I worked on protein and enzyme engineering for 10 weeks. In the first month, I worked on protein purification techniques using column chromatography and different biochemical characterizations of enzymes, ranging from pH and temperature optimization, pH and temperature stability, substrate specificity, kinetic parameters, effect of metal ions. In the later months, I worked on computational aspects and structural characterization of PsGH11_F from *pseudopedobacter saltans*, a carbohydrate enzyme xylanase .I also used bioinformatics tools homology modelling using Modeller, Molecular docking and Molecular dynamics simulations. This whole internship deepened my interests in protein engineering.

After I got back to college, I started my undergraduate project in an enzyme engineering laboratory under the supervision of Prof. S.K Srivastava. Here, I worked on the beta-glucosidase enzyme, its production optimization from fungi Aspergillus wentii and later did various biochemical characterizations of the enzyme. I also investigated opportunities for its industrial applications. I successfully optimized the growth media for production and demonstrated some useful industrial applications of beta-glucosidase like saponin extraction from soapnut (*spanidus Mukorossi*).

For the summer after my third year, I was selected for the Taiwan Experience Exchange Programme scholarship, which supported a visiting internship in Taiwan at Chang Gung University's, Department of Chemical and Materials Engineering in Prof. Liu's cell engineering

lab. Here, I explored biomaterials for gene delivery and drug delivery applications. Specifically, I worked on the preparation of curcumin loaded layer by layer nanoemulsion. After successful layer formation, I performed physiochemical characterizations of emulsions using various instruments like TEM (transmission electron microscope), contact angle, HPLC (high performance liquid chromatography), Zeta-sizer, FTIR-Spectroscopy, and viscometers. I had the opportunity to present my work at a national conference in CGU. I also worked on animal (mouse) models to measure the bioavailability of the drug in mouse blood. I also learned cell culture techniques. During this internship, I appreciate that I got the chance to interact with a community of international researchers and learned to work on multi-culture environment.

When I returned to college, I was selected for the FRT (Future Talent Research) scholarship to participate in a 3 month-long summer internship at the Australian National University in the Jackson lab within the Research School of Chemistry. However, as the COVID-19 pandemic developed, the plan to visit was postponed. Nonetheless, I started working remotely in April. My objective was to predict resistance mutations in RdRp (RNA dependent RNA polymerase), the main target protein for major drugs. Such research may prolong the clinical usefulness of drugs such as remdesivir and favipiravir. For this, I used computational methods , and I set up a collaboration between the Jackson lab and the Dubey lab, at IIT(BHU). Through this collaboration, I assisted in writing a combined project proposal for the Indo-Australian Project Proposal. This project deepened my interest in protein engineering, specifically on its applicability to combating drug resistance, a major issue posing threat to coming generations. I also continued this work as my master's project with Professors V.K Dubey from IIT(BHU) and Colin Jackson from ANU. So far, I have successfully predicted some potential mutations which stabilize the binding of drug, which were later found in the homologous sequences of SARS-2-CoV. I plan to publish near the end of this year.

Over the course of this pandemic, I had a lot of time at home and wanted to contribute to society, so I joined a remote project at the University of Edinburgh in the Leo Rios lab of synthetic biology and automation. My work here is on automating CRISPR based COVID-19 diagnostics using Opentron OT-2 robots. I have so far reviewed available CRISPR based covid-19 diagnostics to identify bottlenecks that could be automated. As my goal is to get low cost automation with a single robot and high-throughput, I also reviewed methods through which we can produce the reagents used in diagnostics in an economic manner, so . All the reviewed materials are framed in a manuscript, which will be submitted for publication by the end of September. Currently I am writing the python protocol to automate the Opentron OT-2 to perform the tasks. While learning of the applications of synthetic biology (majorly CRISPR), I became strongly motivated to pursue more medically-focused research.

Future Objectives

I am now hoping to enter a Joint Ph.D. program to pursue research in protein engineering and/or bioremediation techniques. I ama more interested in the project Microbial cycling of arsenic in aquifers which involves microbial degradation. I have experience working on plastic degration using enzymes which will certainly help during this project.

My goal of earning a Ph.D. stems from my drive to contribute to society in the greatest manner I see possible for myself (given my background and skillset). Graduate school offers the opportunity to focus exclusively on an independent project and generate novel advancements in a scientific discipline with much fewer outside commitments than most other stages of a researcher's career. I am extremely excited by the thought of this unique opportunity. Graduate school is a critical step in my education to enable continued pursuit of my interests, and I feel strongly that Caltech division of chemistry and chemical engineering offers the best resources and environment to make it successful and exciting. I would be honoured to join the IIT KGP and University of Manchester community and thank you for your consideration.