Documentation – Quazar Technologies

* In the preliminary stages of the internship, we read up on crystals and X-ray diffraction from past course material and online resources.
* After a week of this, communication began with Dr. Deshdeep Sahdev and Mr. Aman Abhishek Tiwari, who guided us throughout the entire duration of the work. We started with studying up on Solid State Physics from *Solid State Physics, Neil David Ashcroft, N. David Mermin*.
* We started with Chapter 4 titled *Crystal Lattices* of the textbook. This chapter covers the basics of solid-state physics. It covers topics like Lattices, Bravais Lattices, Unit Cell and Primitive Unit Cell along with examples of some crystal shapes.
* Over the span of 3-4 days, meetings were held with Dr. Deshdeep and Mr. Aman. In these meetings, Dr. Deshdeep would lecture us on these chapters following which discussions were held on the topic.
* As such, we completed the material and proceeded to solve all the sums in the exercise of the chapter. We sent the solutions to Dr. Deshdeep and Mr. Aman for review. No prerequisite was as such needed to complete this but a basic 10+2 knowledge of crystal structure definitely helped.
* We moved on to chapter 5 titled *The Reciprocal Lattice,* immediately after completing the solutions of chapter 4.
* Following the same process, we completed chapter 5 be the end of the first week.
* All the sums in the exercises were solved and their solutions were sent for review. Pre-requisite knowledge of momentum spaces in Quantum Mechanics and vector operations is needed to study this chapter.
* Skipping chapter 6 for the time-being, we moved on to chapter 7 titled *Bravais Lattices and Crystal Systems*. This chapter become the base for most of our work.
* The next week was spent in studying through the chapter and decoding everything in the chapter. A lot of the time went in understanding the 7 crystal systems and the symmetry operations in crystals, due to the shortage of beginner literature on the topic.
* We covered the space groups and point groups. The meetings we held that week went in discussing the nature of these space groups, understanding the Schoenflies and international notation of the space groups.
* We completed the sums at the end of the chapter and sent the solutions for review.
* Following this, we moved on to the University College London website on the 230 space groups. We went through the different space groups in the 7 crystal systems.
* We were then tasked with making some interactable examples for some of the space groups.
* We went about this by taking the existing clickable examples from their website, extracting the HTML code and saving it onto our systems. From there, we would choose a particular space group to work on, download the image of its 2-D projection from the website and manipulate it using photo editing tools like Photoshop or Inkscape (Open-source) to highlight the symmetry operations taking place in the group. We would do this for each and every operation, creating separate images and HTML files for each. In the images, we would locate the coordinates of points and using the <map> tag in HTML, we would link that area to a page that displayed what operation we can use to get there.
* Using this procedure, we created examples for groups 14, 16, 17, 18, 20, 22, 25, 136 and 141.
* The source code for the examples were then uploaded to a Github Repository and shared with Mr. Aman. The examples can be used to get a clarity on these difficult to visualize and less explored crystal symmetries and systems and also be used as educational material for newcomers in the field of crystallography.