Module 4 : Theory of covering spaces  
Lecture 19 : Deck transformations

Exercises:

1. Suppose that $\mathcal{G}$ and $\tilde{\mathcal{G}}$ are topological groups and $p : \tilde{\mathcal{G}} \rightarrow \mathcal{G}$ is a covering projection that is also a group homomorphism then $\ker p = \text{Deck}(\tilde{\mathcal{G}}, \mathcal{G})$.

2. Determine the deck transformations for the covering $\sin : \mathbb{C} - \left\{ \frac{\pi}{2} + k\pi : k \in \mathbb{Z} \right\} \rightarrow \mathbb{C} - \{ \pm 1 \}$

3. Determine the deck transformations for the covering $p : \mathbb{C} - \{ \pm 1, \pm 2 \} \rightarrow \mathbb{C} - \{ \pm 2 \}$ given by $p(z) = z^3 - 3z$. Show that this covering is not regular. Hint: Use Riemann's removable singularities theorem to show that a deck transformation must be analytic on the whole plane.

4. If $p$ is a prime, what can you say about the group of deck transformations of a $p$-sheeted covering space?

5. Show using the universal property that the universal covering, if it exists is unique upto isomorphism of covering projections.