This series of talks gives fundamental ideas, methods and results in analysis on covering spaces. The main focus is put on spectral analysis on covering graphs over a finite graph. Analogy to algebraic number theory and algebraic geometry turns out to be useful. Some results for manifolds will be also discussed.

**Lecture 1 - graduate talk**

**Analysis on covering spaces**

Starting with a quick review of covering spaces, we will handle Laplacians on covering manifolds and graphs. The notion of twisted Laplacians plays a significant role in our discussion. Indeed, this provides us with a unified tool to construct isospectral manifolds and graphs, to establish a relation between fundamental groups and spectra, and to give a family of expanders. Cayley graphs and crystal lattices are treated as examples of covering graphs.

**Lecture 2 - colloquium**

**Abel-Jacobi maps and Albanese maps in graph theory**

It is observed that a graph version of Abel-Jacobi maps is related to Albanese maps of graphs, which is a canonical harmonic map into a torus with a flat metric. The notion of Albanese maps (and its generalization) is used for geometric crystallography. For an illustration, we will treat the diamond twin which has the same property of symmetry as the diamond crystal and has been pinned down in the study of random walks on crystal lattices.

**Lecture 3 - colloquium**

**Large deviation asymptotics of the heat kernels on periodic manifolds**

As one of long-time behaviors of the heat kernel, we look at a large deviation asymptotic of the one on a periodic manifold, an infinite fold abelian covering manifold over a closed manifold. Twisted Laplacians associated with non-unitary characters play an essential role in our discussion. A discrete version (random walks on crystal lattices) is also mentioned.