



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

Name of the Student : SUMIT KUMAR RANO  
Roll Number : 156123004  
Programme of Study : Ph.D.  
Thesis Title : Some Aspects of Poisson Transform on Homogeneous Trees  
Name of Thesis Supervisor(s) : Dr. Pratyooosh Kumar  
Thesis Submitted to the Department/ Center : Mathematics  
Date of completion of Thesis Viva-Voce Exam : 14-12-2020  
Key words for description of Thesis Work : Homogeneous Tree, Poisson Transform, Laplacian, Eigenfunction, Restriction Theorem, Fourier Analysis, Chaos.

---

**SHORT ABSTRACT**

In this thesis, we study certain properties of the eigenfunctions of the Laplacian and their application in harmonic analysis on homogeneous trees. The topics we study in the thesis are the following:

First we characterize all eigenfunctions of the Laplacian on homogeneous trees, which are the Poisson transform of  $L^p$  functions defined on the boundary. Using the duality argument, we also prove the restriction theorem for the Helgason–Fourier transforms on a homogeneous tree.

In 1980 J. Roe proved that if  $\{f_k\}_{k \in \mathbb{Z}}$  is a doubly infinite sequence of functions in  $\mathbb{R}$  which is uniformly bounded and satisfies  $df_k/dx = f_{k+1}$  for all  $k \in \mathbb{Z}$  then  $f_0(x) = a \sin(x + \theta)$  for some  $a, \theta \in \mathbb{R}$ . Later in 1993 Strichartz suitably extended the above result to  $\mathbb{R}^n$ . The second topic of this thesis mainly deals with some variant of their results for homogeneous trees.

At last we study the chaotic dynamics of semigroups generated by the Laplacian. Let  $f$  be a non-constant complex holomorphic function defined on a

connected open set containing the  $L^p$ -spectrum of the Laplacian  $\mathcal{L}$  on a homogeneous tree. In this work we give a necessary and sufficient condition for the semigroup  $T(t) = e^{t\mathcal{L}}$  to be chaotic on  $L^p$ -spaces. It includes some of the important semigroups such as the heat semigroup and the Schrödinger semigroup.

