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Woldegebriel Assefa,

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Preface

In this paper we shall present the basic theory of Sturm-Liouville boundary value problem (BVP) together with a discussion of some of the powerful methods that are used to solve the Sturm-Liouville boundary value problem (SLBVP). Especially the paper focuses on Eigen values and Eigen functions of SLBVP. We devoted much time to the SLBVP due to their particular importance in solving many physical problems in physics, engineering, and other many sciences such as surface heat transfer, vibrations of a vibrating string, transverse displacements in a stretched string, a vertically hung elastic bar, heat flow in a non uniform rod, circularly symmetric heat flow, and the like.

The main objective of this paper is to investigate the existence of Eigen values and Eigen functions of a Sturm-Liouville boundary value problem.

The paper consists of four main sections: The first section, the introductory part, deals about general introduction and some preliminary considerations. In the second section, the SLBVP will be defined and discussed; Eigen values and Eigen functions of SLBVP will be defined & elaborated through examples. And then some basic properties of SLBVP (theorems on SLBVP) are stated and clarified where the proofs of most of these properties are also included. Having familiarized with SLBVP in the second section, in the third section,(the core part of the paper), We will come across with Eigen function expansion and existence of Eigen values; not only this more additional properties of the Eigen values and Eigen function of the SLBVP such as the completeness of Eigen functions, the Rayleigh quotient are presented in this section. In the last section, a method of solving non homogeneous SL type BVPs is presented where the existence of solution of non homogeneous second order SL type BVPs will be compared with analogous SLBVPs.

It should be pointed out that these topics are far more in depth than what will be covering here. In fact we can do a whole course on these topics.