ABSTRACT

A Spectral element method is proposed for the solution of Poisson's problem defined in rectangularly decomposable domains. In this method the domain is broken into two subdomains. The trail functions to be chosen are the eigenfunctions of the differential operator in each subdomain and the solution in each region is expressed in terms of chebyshev polynomial. The coefficient of series expansions are then determined by matching the solution and one of its derivatives across the contiguous domains using the Galerkin and the Collocation formulations. The thesis is summarized as follows:

In Chapter 1 contains a brief description of partial differential equations and numerical techniques for their solutions. A description of some of the properties of Fourier series, eigenfunctions expansions, and the chebyshev polynomial all of its properties and orthogonality conditions are provided.

In Chapter 2 we comprise the fundamentals of Spectral method with a brief introduction of its various versions. The domain decomposition technique also provided. The Galerkin and Collocation methods are also described. A review of the research work performed in this area is also provided in Literature survey.

The Chapter 3 consists of implementation of Spectral Element Method for the solution of Poisson's equation in the contraction geometry. The domain is divided into two semi-infinite rectangular regions and the solution in each region is expressed in terms of Chebyshev Polynomial in such a way that the boundary conditions are automatically satisfied. The coefficients of expansions are determined by matching the solutions and one of its derivatives in regions across their common interface. The Galerkin and Collocation formulations of matching conditions have been used. The matching process produces an infinite system of algebraic equations for the unknown expansion coefficients.

The chapter 4 consists of the numerical results and the implementation of the Galerkin and Collocation methods on Laplace equation to find its unknowns. The effectiveness of Eigenfunctions Expansions in achieving exponential convergence has been confirmed by using both Galerkin and Collocation formulations of matching conditions to determine the unknown coefficients. We conclude this study with some closing remarks.