PREFACE

The evaluation of integrals is a recurring problem in many branches of both pure and applied mathematics. In the areas such as Control theory, Finite element analysis, etc, many problems require computation of integrals on a large scale. Such problems can only be solved with the help of computers. It is of vital importance to be able to compute integrals of functions belonging to a wide class of functions. Therefore, numerical integration is one of the most fascinating and basic topic in numerical analysis.

Since the sixteenth century, many numerical integration methods have been developed. Numerical integration formulae are also called as ´mechanical quadratures´ or simply ´quadratures´ if these are applied to function of one variable only. Integration formulae are classified mainly into two groups :(i) The Newton-Cotes integration methods, (ii) Gaussian integration methods. The present dessertation entitled, " NUMERICAL INTEGRATION METHODS AND THEIR COMPUTER IMPLEMENTATION " attempts to discuss the theoretical aspects of these methods and to develop computer programs for some of these methods.

This dissertation consists of four chapters. In chapter-I we have given first of all the introduction of numerical integration and discussed its necessity. Next, we have given basic information of some related topics. Also, this chapter essentially contains some basic definitions and statements of the theorems which are subsequently used in this dissertation.

Chapter-II is mainly concerned with Newton-Cotes integration formulae of both closed and open types. First, we have considered general closed type formula with its error term and then discussed its various special cases such as the trapezoidal rule, Simpson's 1/3-rd rule, etc. Next, we derived the Newton-Cotes open integration formula in the general form and then its special cases are presented alongwith their corresponding error terms. Further, we explained the composite form of these formulae. Here, as an example, we considered the composite trapezoidal rule and composite Simpson's 1/3 rd rule. Also, we have compared both types of Newton-Cotes formulae for their merits and demerits. Further we have discussed splines and derived cubic spline interpolation formula which is further used to obtain the spline integration formula. At last, we have tried to analyze errors in these methods.

Chapter-III is devoted to Gaussian quadratures. First, we considered orthogonal polynomials as these play an important role in Gaussian quadratures. After, we have derived Gauss-Legendre quadrature, Gauss-Laguerre quadrature, Gauss-Chebyshev quadrature and Gauss-Hermite quadrature. Next, some brief informations of other Gaussian quadrature formulae such as the Lobatto quadrature, the Radau quadrature are given. We also discussed the integration formulae of Gauss type where a certain number of abscissas are preassigned. We have tried to discuss the convergence of Gaussian rules and then some attempts are made to discuss the errors for the Gaussian quadratures with the help of available results. Finally we have presented the merits and demerits of Gaussian quadratures.

The past generation, under the impact of the electronic computer, has witnessed an anormous productivity in the field of numerical analysis. Therefore, computer implementation of integration methods is necessary. We prepared computer programs in 'C' for some selected integration methods These programs are given in chapter-IV of this dissertation. Integrals of four functions are evaluated using each of these programs. The outputs are shown and also compared with their true values.

In the appendix, we present a table showing base points and weights for Gauss-Legendre quadrature formulae for n = 2,3,4,5,6,7,8,10 and 12.

The references are given at the end. These are arranged in alphabetical order. In the text these are refered to by putting within rectangular brackets. For example, [4,pp 76] means page 76 of the fourth reference in the list of references.