

Contents

Abstract	iii
Resumen	v
Resum	vii
Acknowledgments	ix
Agradecimientos	xi
Contents	xiii
List of Symbols	xvii
1 Introduction	1
1.1 Motivation and objectives	1
1.2 Thesis outline	3

2 State of the art	5
2.1 Neutron Diffusion Equation	5
2.2 Neutron Transport Equation	13
2.3 Spatial Discretization	24
2.4 Finite Volume Method	28
2.5 Calculation of Eigenvalue Problems.	34
2.6 Time dependent Ordinary Differential Equations.	41
3 Steady State of the Neutron Diffusion Equation with the Finite Volume Method	47
3.1 Two-energy group Neutron Diffusion Equation	47
3.2 Calculation of the face averaged values of fluxes and currents	50
3.3 Multigroup formulation	69
3.4 Solution of the Eigenvalue Problem	72
3.5 Parallelization	75
4 Modal Method for the time dependent Neutron Diffusion Equa- tion	79
4.1 Modal Method	79
4.2 Adjoint calculation	88
4.3 Updating modes	95
5 Steady State of the Neutron Transport Equation with the Discrete Ordinates formulation and the Finite Volume Method	97
5.1 Discrete Ordinates formulation	97
5.2 Gauss-Legendre Product Quadrature	108
5.3 Interpolation schemes for the face values	110
6 Results	115
6.1 Evaluation of the results	115
6.2 Moving Least Squares method	118
6.3 Inter-cells polynomial expansion method	135

6.4 Improved inter-cells polynomial expansion method.	143
6.5 Multigroup formulation.	157
6.6 Parallelization	170
6.7 Adjoint calculation.	177
6.8 Modal method.	180
6.9 Neutron Transport Equation with the Discrete Ordinates and FVM.	184
7 Conclusions	207
7.1 Conclusions.	207
7.2 Future work	214
7.3 Scientific contribution.	216
Bibliography	221