

B. Herman and J. Roberts

# Nuclear Reactor Core Methods

April 3, 2012

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# Preface

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A preface is a book's preliminary statement, usually written by the *author or editor* of a work, which states its origin, scope, purpose, plan, and intended audience, and which sometimes includes afterthoughts and acknowledgments of assistance.

When written by a person other than the author, it is called a foreword. The preface or foreword is distinct from the introduction, which deals with the subject of the work.

Customarily *acknowledgments* are included as last part of the preface.

Place(s),  
month year

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# Contents

## Part I Fundamentals

<b>1</b>	<b>Neutron Transport Equation</b> .....	3
1.1	Terminology .....	3
1.2	Derivation of Neutron Transport Equation .....	3
<b>2</b>	<b>Multigroup Neutron Diffusion Equation</b> .....	5
2.1	Continuous Energy Diffusion Equation .....	5
2.2	Derivation of Multigroup Diffusion Equation .....	5
<b>3</b>	<b>Finite Difference Methods</b> .....	7
<b>4</b>	<b>Finite Volume Methods</b> .....	9
<b>5</b>	<b>Finite Element Methods</b> .....	11
<b>6</b>	<b>Stationary Iterative Methods</b> .....	13
<b>7</b>	<b>Nonstationary Iterative Methods - Krylov Subspace Methods</b> .....	15
<b>8</b>	<b>Conjugate Gradient</b> .....	17
<b>9</b>	<b>GMRES</b> .....	19
<b>10</b>	<b>Power Iteration</b> .....	21
<b>11</b>	<b>Nonlinear Iteration</b> .....	23
<b>12</b>	<b>Chebyshev Acceleration Method</b> .....	25
<b>13</b>	<b>Time Stepping Methods</b> .....	27

## Part II Reactor Statics

<b>14</b>	<b>Classical Nodal Methods - Flare Model</b>	<b>31</b>
<b>15</b>	<b>Analytic Nodal Method</b>	<b>33</b>
<b>16</b>	<b>Nodal Expansion Method</b>	<b>35</b>
<b>Part III Reactor Dynamics</b>		
<b>A</b>	<b>Chapter Heading</b>	<b>39</b>
	A.1 Section Heading	39
	A.1.1 Subsection Heading	39
	<b>Glossary</b>	<b>41</b>
	<b>Index</b>	<b>43</b>

# Acronyms

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Lists of abbreviations, symbols and the like are easily formatted with the help of the Springer-enhanced `description` environment.

PWR	Pressurized Water Reactor
BWR	Boiling Water Reactor
ANM	Analytic Nodal Method



# **Part I**

## **Fundamentals**

Lorem ipsum...

# Chapter 1

## Neutron Transport Equation

**Abstract** Each chapter should be preceded by an abstract (10–15 lines long) that summarizes the content. The abstract will appear *online* at [www.SpringerLink.com](http://www.SpringerLink.com) and be available with unrestricted access. This allows unregistered users to read the abstract as a teaser for the complete chapter. As a general rule the abstracts will not appear in the printed version of your book unless it is the style of your particular book or that of the series to which your book belongs.

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### 1.1 Terminology

Definition of all terms (flux, current etc.) Just a copy paste of 106 notes I am sure

### 1.2 Derivation of Neutron Transport Equation

Jeremy I am sure you have this done from 106.





## Chapter 2

# Multigroup Neutron Diffusion Equation

**Abstract** Each chapter should be preceded by an abstract (10–15 lines long) that summarizes the content. The abstract will appear *online* at [www.SpringerLink.com](http://www.SpringerLink.com) and be available with unrestricted access. This allows unregistered users to read the abstract as a teaser for the complete chapter. As a general rule the abstracts will not appear in the printed version of your book unless it is the style of your particular book or that of the series to which your book belongs.

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### 2.1 Continuous Energy Diffusion Equation

This section will contain the derivation of the continuous form of the diffusion equation from the neutron transport equation.

### 2.2 Derivation of Multigroup Diffusion Equation

This section will contain the derivation of the multigroup diffusion equation from the continuous energy diffusion equation



## Chapter 3

# Finite Difference Methods

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## Chapter 4

### Finite Volume Methods

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## Chapter 5

### Finite Element Methods

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## Chapter 6

# Stationary Iterative Methods

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This chapter will contain the idea of iterative methods, and talk about Jacobi and Gauss - Siedel, example should be provided either for fission source iterations or energy group sweep. Also should include SOR method.



## Chapter 7

# Nonstationary Iterative Methods - Krylov Subspace Methods

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REF: <http://www.netlib.org/utk/papers/templates/node9.html>

Intro to Krylov Methods Arnoldi Iterations - Gram-Schmidt etc?



## Chapter 8

# Conjugate Gradient

**Abstract** Each chapter should be preceded by an abstract (10–15 lines long) that summarizes the content. The abstract will appear *online* at [www.SpringerLink.com](http://www.SpringerLink.com) and be available with unrestricted access. This allows unregistered users to read the abstract as a teaser for the complete chapter. As a general rule the abstracts will not appear in the printed version of your book unless it is the style of your particular book or that of the series to which your book belongs.

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REF: <http://www.netlib.org/utk/papers/templates/node9.html>

Specific example - Conjugate Gradient



## Chapter 9

### GMRES

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REF: <http://www.netlib.org/utk/papers/templates/node9.html>

Specifically derive out GMRES with givens rotations. Preconditioning JFNK?





## Chapter 10

### Power Iteration

**Abstract** Each chapter should be preceded by an abstract (10–15 lines long) that summarizes the content. The abstract will appear *online* at [www.SpringerLink.com](http://www.SpringerLink.com) and be available with unrestricted access. This allows unregistered users to read the abstract as a teaser for the complete chapter. As a general rule the abstracts will not appear in the printed version of your book unless it is the style of your particular book or that of the series to which your book belongs.

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Derive out the power iteration method and give example.



## Chapter 11

### Nonlinear Iteration

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Newton Iteration - with GMRES JFNK



## Chapter 12

### Chebyshev Acceleration Method

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Chebyshev Acceleration of Power iteration



## Chapter 13

### Time Stepping Methods

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Forward Euler (Explicit) Backward Euler (Implicit) Runge-Kutta (4th order mostly used in spatial kinetics) Adams-Moulton Adams-Bashforth





## **Part II**

# **Reactor Statics**

Lorem ipsum...

## Chapter 14

### Classical Nodal Methods - Flare Model

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Summer course on nodal methods (Herman office)



## Chapter 15

# Analytic Nodal Method

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Derivation of Analytic Nodal Method with example code Smith Master Thesis



## Chapter 16

### Nodal Expansion Method

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- Bandini Thesis





**Part III**  
**Reactor Dynamics**

Lorem ipsum...

## Appendix A

### Chapter Heading

*All's well that ends well*

Use the template *appendix.tex* together with the Springer document class SVMono (monograph-type books) or SVMult (edited books) to style appendix of your book in the Springer layout.

#### A.1 Section Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the L<sup>A</sup>T<sub>E</sub>X automatism for all your cross-references and citations.

##### A.1.1 Subsection Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the L<sup>A</sup>T<sub>E</sub>X automatism for all your cross-references and citations as has already been described in Sect. A.1.

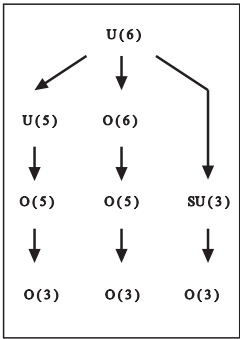
For multiline equations we recommend to use the `eqnarray` environment.

$$\begin{array}{l} \mathbf{a} \times \mathbf{b} = \mathbf{c} \\ \mathbf{a} \times \mathbf{b} = \mathbf{c} \end{array} \quad (\text{A.1})$$

##### A.1.1.1 Subsubsection Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Furtheron please use the

**Fig. A.1** Please write your figure caption here



$\LaTeX$  automatism for all your cross-references and citations as has already been described in Sect. A.1.1.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

**Table A.1** Please write your table caption here

Classes	Subclass	Length	Action Mechanism
Translation	mRNA <sup>a</sup>	22 (19–25)	Translation repression, mRNA cleavage
Translation	mRNA cleavage	21	mRNA cleavage
Translation	mRNA	21–22	mRNA cleavage
Translation	mRNA	24–26	Histone and DNA Modification

<sup>a</sup> Table foot note (with superscript)

# Glossary

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# Index

acronyms, list of, xiii

dedication, v

foreword, vii

glossary, 41

preface, ix

symbols, list of, xiii