# TABLE OF CONTENTS

## CHAPTER 1

**Introduction**

<table>
<thead>
<tr>
<th>1.1. Objective</th>
<th>Page No 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2. History of Queueing Theory</td>
<td>1</td>
</tr>
<tr>
<td>1.3. Description of Queues</td>
<td>2</td>
</tr>
<tr>
<td>1.4. Characteristics of a Queueing System</td>
<td>2</td>
</tr>
<tr>
<td>1.5. Representation of Queues</td>
<td>4</td>
</tr>
<tr>
<td>1.6. Basic Definitions And Notations</td>
<td>5</td>
</tr>
<tr>
<td>1.7. Bulk Service Queueing System</td>
<td>7</td>
</tr>
<tr>
<td>1.8. System Performance Measures</td>
<td>13</td>
</tr>
<tr>
<td>1.9. Stability Analysis</td>
<td>13</td>
</tr>
<tr>
<td>1.10. Applications</td>
<td>14</td>
</tr>
<tr>
<td>1.11. Notations And Symbols</td>
<td>15</td>
</tr>
</tbody>
</table>

## CHAPTER 2

**Single Server Batch Service Queueing System With Multiple Vacations**

<table>
<thead>
<tr>
<th>2.1. Introduction</th>
<th>Page No 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2. Model Description</td>
<td>21</td>
</tr>
<tr>
<td>2.3. Analysis of Steady State Probability Distribution</td>
<td>22</td>
</tr>
<tr>
<td>2.4. Stability Condition</td>
<td>26</td>
</tr>
<tr>
<td>2.5. System Performance Measures</td>
<td>26</td>
</tr>
<tr>
<td>2.6. Numerical Study</td>
<td>27</td>
</tr>
<tr>
<td>2.7. Graphical Study</td>
<td>35</td>
</tr>
</tbody>
</table>
## CHAPTER 3

**Single Server Batch Service Queueing System Under Multiple Vacations With Catastrophe**

3.1. Introduction 37  
3.2. Model Description 38  
3.3. Analysis of Steady State Probability Distribution 39  
3.4. Stability Condition 45  
3.5. Particular Cases 45  
3.6. System Performance Measures 45  
3.7. Numerical Study 47  
3.8. Graphical Study 58

## CHAPTER 4

**Single Server Batch Service Queueing System With Negative Arrivals Under Multiple Vacations**

4.1. Introduction 62  
4.2. Model Description 63  
4.3. Analysis of Steady State Probability Distribution 64  
4.4. Stability Condition 71  
4.5. Particular Case 71  
4.6. System Performance Measures 71  
4.7. Numerical Study 73  
4.8. Graphical Study 84

## CHAPTER 5

**Single Server Batch Service Queueing System Under Multiple Vacations With Unreliable Server**

5.1. Introduction 88  
5.2. Model Description 89  
5.3. Analysis of Steady State Probability Distribution 90  
5.4. Stability Condition 95
CHAPTER 6

Single Server Batch Service Queueing System Under Multiple Vacations With Gated Service

6.1. Introduction 114
6.2. Model Description 115
6.3. Analysis of Steady State Probability Distribution 115
6.4. Stability Condition 118
6.5. System Performance Measures 119
6.6. Numerical Study 120
6.7. Graphical Study 128

CHAPTER 7

Single Server Batch Service Queueing System Under Multiple Vacations With Second Optional Service

7.1. Introduction 130
7.2. Model Description 131
7.3. Analysis of Steady State Probability Distribution 132
7.4. Stability Condition 137
7.5. Particular Case 137
7.6. System Performance Measures 138
7.7. Numerical Study 139
7.8. Graphical Study 152
CHAPTER 8
Single Server Batch Service Queueing System Under Multiple Vacations With Bernoulli Schedule

8.1. Introduction 156
8.2. Model Description 157
8.3. Analysis of Steady State Probability Distribution 158
8.4. Stability Condition 161
8.5. Particular Case 162
8.6. System Performance Measures 162
8.7. Numerical Study 163
8.8. Graphical Study 173

CHAPTER 9
Single Server Batch Service Queueing System Under Multiple Vacations With Loss And Feedback

9.1. Introduction 177
9.2. Model Description 178
9.3. Analysis of Steady State Probability Distribution 178
9.4. Stability Condition 183
9.5. Particular Case 183
9.6. System Performance Measures 183
9.7. Numerical Study 184
9.8. Graphical Study 194

CONCLUSIONS 198
REFERENCES