# PhD in Information Technology

## Algorithms Essentials

### PhD Qualifying Exam Study Guide

**Primary Course:**
AIT 512: Algorithms and Data Structures Essentials

**Primary Textbook:**
*Algorithms, 4th Edition* by Robert Sedgewick and Kevin Wayne

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
<th>Readings</th>
</tr>
</thead>
</table>
| **Fundamentals of Algorithms** | 1. Programming Model  
2. Data Abstraction  
3. Bags, Queues, and Stacks  
4. Analysis of Algorithms  
5. Union Find | Chapter 1 |
| **Sorting**            | 1. Elementary Sorts  
2. Mergesort  
3. Quicksort  
4. Priority Queues  
5. Applications of sorting | Chapter 2 |
| **Searching**          | 1. Elementary Symbol Tables  
2. Binary Search Trees  
3. Balanced Search Trees  
4. Hash Tables  
5. Application of Searching | Chapter 3 |
| **Graphs**             | 1. Undirected Graphs  
2. Directed Graphs  
3. Minimum Spanning Trees  
4. Shortest Paths | Chapter 4 |
| **Strings**            | 1. String Sorts (LSD, MSD, 3way)  
2. Tries  
3. Substring Search  
4. Regular Expressions  
5. Data Compression | Chapter 5 |
<table>
<thead>
<tr>
<th>Advanced Topics</th>
<th>1. Event-driven Simulations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. B-Trees</td>
</tr>
<tr>
<td></td>
<td>3. Suffix Arrays</td>
</tr>
<tr>
<td></td>
<td>4. Maxflow</td>
</tr>
<tr>
<td></td>
<td>5. Reductions</td>
</tr>
<tr>
<td></td>
<td>6. Intractability</td>
</tr>
<tr>
<td></td>
<td>Chapter 6</td>
</tr>
</tbody>
</table>