

# Cryptography

## Past, Present and Future

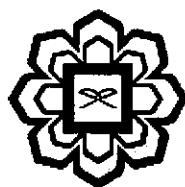
Imad Fakhri Taha Al Shaikhli



IIUM PRESS  
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

# **Cryptography: Past, Present and Future**

**Imad Fakhri Taha Al Shaikhli**



**IIUM Press**

Published by:  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011

©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia      Cataloguing-in-Publication Data

Imad Fakhri Taha Al-Shaikhli  
Cryptography: Past, Present and Future  
Imad Fakhri Taha Al-Shaikhli

ISBN: 978-967-418-091-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed by :  
**IIUM PRINTING SDN. BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan

# TABLE OF CONTENTS

Dedication	I
Preface	Vii
Acknowledgement	Viii
<b>PART I Classical Cryptography</b>	1
<b>Chapter One Introduction</b>	3-9
- Imad Fakhri Taha Al Shaikhli	
- Rusydi Hasan	
- Nurhidayah Binti Abdulrashid	
- Faizurimawaty Bt Padzilah	
- Nabilah Bt Abd Rahman	
<b>Chapter Two Monoalphabetic Substitution Cipher</b>	11-16
- Imad Fakhri Taha Al Shaikhli	
- Rusydi Hasan	
- Nurhidayah Binti Abdulrashid	
- Faizurimawaty Bt Padzilah	
- Nabilah Bt Abd Rahman	
<b>Chapter Three Polyalphabetic Subsitution Cipher</b>	17-23
- Imad Fakhri Taha Al Shaikhli	
- Rusydi Hasan	
- Nurhidayah Binti Abdulrashid	
- Faizurimawaty Bt Padzilah	
- Nabilah Bt Abd Rahman	
<b>Chapter Four Machine-Based Cryptography</b>	25-30
- Rusydi Hasan	
- Imad Fakhri Taha Al Shaikhli	
- Nurhidayah Binti Abdulrashid	
- Faizurimawaty Bt Padzilah	
- Nabilah Bt Abd Rahman	
<b>PART II Modern Symmetric-Key Cryptography</b>	31
<b>Chapter Five Block and Stream Cipher</b>	33-38
- Sufyan Salim Mahmood Al Dabbagh	
- Imad Fakhri Taha Al Shaikhli	
- Muhammad Fadil Lubis	
- Usman bin Mohd Azhar	
- Nopan Ziro Ando	
<b>Chapter Six Data Encryption Standard (DES)</b>	39-46
- Imad Fakhri Taha Al Shaikhli	

- Sufyan Salim Mahmood Al Dabbagh
- Muhammad Fadil Lubis
- Usman bin Mohd Azhar
- Nopan Ziro Ando

**Chapter Seven Advanced Encryption Standard(Rijndael)**

47-52

- Sufyan Salim Mahmood Al Dabbagh
- Imad Fakhri Taha Al Shaikhli
- Muhammad Fadil Lubis
- Usman bin Mohd Azhar
- Nopan Ziro Ando

**Chapter Eight Trivium and Rabbit Stream Cipher**

53-61

- Imad Fakhri Taha Al Shaikhli,
- Sufyan Salim Mahmood Al Dabbagh
- Muhammad Fadil Lubis
- Usman bin Mohd Azhar
- Nopan Ziro Ando

**PART III Hash Functions**

63

**Chapter Nine Introduction**

65-72

- Khanssaa Munthir Abdulmajed
- Imad Fakhri Taha Al Shaikhli
- Sufyan Salim Mahmood Al Dabbagh
- Ahmad Faridi Abdul Matin
- Sibomana Hilali Hussein

**Chapter Ten Message Digest (MDX) Family**

73-80

- Imad Fakhri Taha Al Shaikhli
- Sufyan Salim Mahmood Al Dabbagh
- Khanssaa Munthir Abdulmajed
- Ahmad Faridi Abdul Matin
- Sibomana Hilali Hussein

**Chapter Eleven SHA family hash function**

81-87

- Khanssaa Munthir Abdulmajed
- Imad Fakhri Taha Al Shaikhli
- Sufyan Salim Mahmood Al Dabbagh
- Ahmad Faridi Abdul Matin
- Sibomana Hilali Hussein

**Chapter Twelve RIPEMD and Chameleon Hash Function**

89-96

- Sufyan Salim Mahmood Al Dabbagh
- Imad Fakhri Taha Al Shaikhli
- Khanssaa Munthir Abdulmajed
- Ahmad Faridi Abdul Matin

- Sibomana Hilali Hussein

## **PARTIV Public Key & Digital Signature Schemes**

97

### **Chapter Thirteen Rivest-Shamir-Adleman (RSA)**

99-105

- Iqram Mohammed Hayek
- Imad Fakhri Taha Al Shaikhli
- Sufyan Salim Mahmood Al Dabbagh
- Kusai Abu Hilal

### **Chapter Fourteen Cryptanalysis of RSA**

107-112

- Imad Fakhri Taha Al Shaikhli
- Sufyan Salim Mahmood Al Dabbagh
- Iqram Mohammed Hayek
- Kusai Abu Hilal

### **Chapter Fifteen Digital Signature Algorithm**

113-115

- Sufyan Salim Mahmood Al Dabbagh
- Imad Fakhri Taha Al Shaikhli
- Iqram Mohammed Hayek
- Kusai Abu Hilal

## **Part V Zero-Knowledge Proof**

116

### **Chapter Sixteen Background of Zero-Knowledge Proof**

117-120

- Imad Fakhri Taha Al Shaikhli
- Rusydi Hasan
- Siti Khairunnisa Mohd Bakri
- Nur Dalilah Bt More Yusoff
- Nur Khairunnisa Bt Juarah

### **Chapter Seventeen Interactive Proof Systems**

121-126

- Rusydi Hasan
- Imad Fakhri Taha Al Shaikhli
- Siti Khairunnisa Mohd Bakri
- Nur Dalilah Bt More Yusoff
- Nur Khairunnisa Bt Juarah

### **Chapter Eighteen Zero-Knowledge Proof**

127-132

- Imad Fakhri Taha Al Shaikhli
- Rusydi Hasan

- Siti Khairunnisa Mohd Bakri	
- Nur Dalilah Bt More Yusoff	
- Nur Khairunnisa Bt Juarah	
<b>Chapter Nineteen Feige-Fiat-Shamir Identification Scheme</b>	<b>133-138</b>
- Rusydi Hasan	
- Imad Fakhri Taha Al Shaikhli	
- Siti Khairunnisa Mohd Bakri	
- Nur Dalilah Bt More Yusoff	
- Nur Khairunnisa Bt Juarah	
<b>Part VI Secret Sharing</b>	<b>139</b>
<b>Chapter Twenty Introduction</b>	<b>141-146</b>
- Muhammad Israfil	
- Imad Fakhri Taha Al Shaikhli	
- Sufyan Salim Mahmood Al Dabbagh	
<b>Chapter Twenty One Shamir's Threshold Scheme</b>	<b>147-150</b>
- Imad Fakhri Taha Al Shaikhli	
- Sufyan Salim Mahmood Al Dabbagh	
- Muhammad Israfil	
<b>Chapter Twenty Two Blakely's Secret Sharing Scheme</b>	<b>151-155</b>
- Sufyan Salim Mahmood Al Dabbagh	
- Imad Fakhri Taha Al Shaikhli	
- Muhammad Israfil	
<b>Part VII Quantum Cryptography</b>	<b>156</b>
<b>Chapter Twenty Three Quantum Cryptography</b>	
- Azeddine Messikh	

# **Chapter 23**

## **Quantum cryptography**

### **Abstract**

Quantum cryptography offers a secure communication between two parties against eavesdroppers with unlimited computing power. It is based on physical laws and does not rely upon any complexity assumptions. This chapter presents some mathematical foundation for the study of quantum cryptography which will be of great help to understand how the first quantum cryptography named BB84 works. Before going into details, we shall first introduce the postulates of quantum physics.