UTM

UNIVERSITY of TECHNOLOGY, MAURITIUS

School of Innovative Technologies and Engineering

Department of Industrial Systems and Engineering

BSc (Hons) Computer Science with Network Security

PROGRAMME DOCUMENT

VERSION 5.0
December 2015

BSc (Hons) Computer Science with Network Security

A. Programme Information

The Bachelor of Computer Science with Network Security aims at producing graduates with knowledge and skills to have a productive career as professionals in the computing industry more specifically in the area of network and security administration of computing resources.

This programme is a three-year program of study that emphasizes the mathematical and theoretical foundations of computing as well as the key skill of programming with focus on networking aspect and security. The student embark on general computing studies such as computer architecture, software development, database system, operating systems as well as network and security related areas such as network programming, data and network security and wireless network security. The programme also prepares the student for management, communication, and legal aspects through interactive seminars.

B. Programme Aims

Most information system nowadays is growing more and more complex and networked. At the same time, the risks of security attacks on such networks is becoming significant as most business relies on the computer system for storage and processing of critical and sensitive information. The BSc (Hons) Computer Science with Network Security is thus designed to produce graduates with a sound knowledge of today's networked infrastructure and skills to be able to properly design, implement and secure such complex and distributed systems. The curriculum provides a balanced and intellectually stimulating programme of theoretical and practical work.

C. Programme Objectives

After successful completion of the Programme, the graduate will be able to:
- Appreciate the functioning of a computer system and its operating systems
- Understand the principles of software development and data modelling
- Develop standalone or distributed applications
- Develop web and mobile applications
- Design and develop network based solutions
- Design a secured network using different available technologies such as cryptography, firewalls and intrusion, detection systems
- Communicate both orally and in writing using traditional and electronic media

PART I - Regulations

D. General Entry Requirements

As per UTM'S Admissions Regulations, and 'Admission to Programmes of Study at First Degree Level'

E. Programme Entry Requirements

'A' Level in Mathematics or in another science subject including Computer Science

F. Programme Mode and Duration

Full Time: 3 years (6 Semesters)
Part Time: 4 years (8 Semesters)

G. Teaching and Learning Strategies
- Lectures, Tutorials and Practical Laboratory Sessions
- Structured Discussions and Self-Directed Study
- Workshops and Seminars
- Work Placement or Project Portfolio

H. Attendance Requirements

As per UTM's Regulations and Policy

I. Credit System

1 module   = 3 or 4 credits
Computer Science Project   = 9 credits

J. Student Progress and Assessment

For the award of the Degree, all modules must be passed overall with passes in the examinations, coursework and other forms of assessment. All modules will carry 100 marks and will be assessed as follows (unless otherwise specified):

- Written and/or practical examination, and continuous assessment carrying up to 40% of total marks.
- Seminars are assessed on continuous assessment only. Each seminar must consist of a ***minimum of two*** assessments.
- Continuous assessment can be based on a combinations of assignments, workshops, practical labs or/and or class tests.
- The final year "Computer Science Project" carries 300 marks.

K. Evaluation of Performance

The percentage mark at Level 1 contributes a 20% weighting towards the degree classification.
The percentage mark at Level 2 contributes a 30% weighting towards the degree classification.
The percentage mark at Level 3 contributes a 50% weighting towards the degree classification.

Module grading structure:

Grade	Marks x (%)
A	$70 \leq x$
B	$60 \leq x < 70$
C	$50 \leq x < 60$
D	$40 \leq x < 50$
F	$x < 40$
A-D	Pass
F	Fail

L. Award Classification

Overall weighted mark y (%)	Classification
$y \geq 70$	1st Class Honours
$60 \leq y < 70$	2nd Class 1st Division Honours
$50 \leq y < 60$	2nd Class 2nd Division Honours
$45 \leq y < 50$	3rd Class Honours
$40 \leq y < 45$	Pass Degree
$y < 40$	No Award

M. Programme Organisation and Management
Programme Director: Dr Sandhya Armoogum

Contact Details:
- Room: G2.16
- Telephone Number: (+230) 207 5250
- Email: asandya@umail.utm.ac.mu

Part II - Programme Structure

N. BSc (Hons) Computer Science with Network Security – Full Time (Version 5.0)

YEAR 1 (Level 1)

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L+T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L+T/P	**Credits**
MATH1105C	*Mathematics for Computer Science*	2+1	3	WAT1116C	*Internet Programming I*	2+2	4
PROG1101C	*Programming Concepts*	2+2	4	PROG1119C	*Object Oriented Software Development*	2+2	4
SEM1101C	*Professional Practice Seminar*	2+1	3	CAN1101C	*Networks*	2+1	3
CAN1103C	*Data Communications*	2+1	3	SDT 1117C	*Analysis and Design*	2+2	4
DBT1111C	*Database Design*	2+2	4	HCA1109C	*Computer and Microprocessor architecture and programming*	2+2	4

YEAR 2 (Level 2)

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L T/P	**Credits**
WAT2117C	*Internet Programming II*	2+2	4	CAN2113C	*Network Programming*	2+2	4
PROG2104C	*Visual Programming*	2+2	4	PROJ2119C	*Work Placement*		10
CAN2105C	*Switching techniques*	2+2	4				
SECU2114C	*Data and Network Security I*	2+2	4				
OSS2110C	*Operating System Administration*	2+2	4				

YEAR 3 (Level 3)

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L T/P	**Credits**	**Code**	**Modules**	**Hrs/Wk** L T/P	**Credits**
SEM3101C	*Research & Innovation Seminar*	2+1	3	SECU3122C	*Computer Forensics*	2+2	4
CAN2103C	*Communication & Networking Design & Management*	2+2	4	SCG3112C	*Artificial Intelligence*	2+2	4
SECU3114C	*Data and Network Security II*	2+2	4	CAN3116C	*Emerging Networks and Technologies*	2+1	3
MCT3101C	*Mobile and Pervasive Computing*	2+2	4				
PROJ3106C	*Computer Science Project*			PROJ3106C	*Computer Science Project*		9

O. BSc (Hons) Computer Science with Network Security – Part Time (Version 5.0)

YEAR 1

→ *Start of Level 1*

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L P DS	**Credits**	**Code**	**Modules**	**Hrs/Wk** L P DS	**Credits**
MATH1105C	*Mathematics for Computer Science*	2+1	3	SEM1101C	*Professional Practice Seminar*	2+1	3
CAN1103C	*Data Communications*	2+1	3	PROG1101C	*Programming Concepts*	2+2	4
DBT1111C	*Database Design*	2+2	4	CAN1101C	*Networks*	2+1	3

YEAR 2

→ *Start of Level 2*

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L P DS	**Credits**	**Code**	**Modules**	**Hrs/Wk** L P DS	**Credits**
HCA1109C	*Computer and Microprocessor architecture and programming*	2+2	4	WAT2117C	*Internet Programming II*	2+2	4
SDT1117C	*Analysis and Design*	2+2	4	CAN2105C	*Switching techniques*	2+2	4
WAT1116C	*Internet Programming I*	2+2	4	OSS2110C	*Operating System Administration*	2+2	4
PROG1119C	*Object Oriented Software Development*	2+2	4				

End of Level 1 →

YEAR 3

→ *Start of Level 3*

Semester 1				Semester 2			
Code	**Modules**	**Hrs/Wk** L P DS	**Credits**	**Code**	**Modules**	**Hrs/Wk** L P DS	**Credits**
SECU2114C	*Data and Network Security I*	2+2	4	CAN2103C	*Communication & Networking Design & Management*	2+2	4
PROG2104C	*Visual Programming*	2+2	4	SECU3114C	*Data and Network Security II*	2+2	4
CAN2113C	*Network Programming*	2+2	4	SEM3101C	*Research & innovation Seminar*	2+1	3
	Project Portfolio		10				

End of Level 2 →

YEAR 4							
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs/Wk** L P DS	**Credits**	**Code**	**Modules**	**Hrs/Wk** L P DS	**Credits**
MCT3101C	*Mobile and Pervasive Computing*	2+2	4	SCG3112C	*Artificial Intelligence*	2+2	4
SECU3122C	*Computer Forensics*	2+2	4	CAN3116C	*Emerging Networks and Technologies*	2+1	3
PROJ3106C	*Computer Science Project*			PROJ3106C	*Computer Science Project*		9
End of Level 3 $\rightarrow$							

P.   MODULE OUTLINE

MATH1105C: MATHEMATICS FOR COMPUTER SCIENCE
- Proofs, proof by contradiction
- Well ordering principle
- Propositional logic
- Sets, functions and relations
- Predicates and quantifiers
- Graphs and digraphs
- State machines
- Counting, binomial theorem and combinatorial identities
- Pigeonhole principle
- Counting repetitions
- Inclusion-exclusion
- Generating functions
- Discrete probability theory
- Conditional probability and independence
- Sampling and confidence

SEM1101C : PROFESSIONAL PRACTICE SEMINAR
- Organization Structure and role of ICT in organizations
- Ethics in ICT Profession
- Health & Safety Issues in ICT
- IT Contracts
- Intellectual Property – copyright & patents
- Data Protection
- Computer Misuse
- Electronic Transactions
- Green Issues
- Professional communication
  - Carry out presentations
  - Participate and organize meetings
  - Electronic communication

DBT1111C: DATABASE DESIGN
- Introduction to Databases
- Database Environment
- Database Architecture
- The Relational Model
- Relational Integrity
- Entity Relationship Modelling
- Normalisation
- Relational Algebra
- SQL: Data definition and Data Manipulation
- Triggers

CAN1103C: DATA COMMUNICATION
- Introduction to data communication
- Frequency response, bandwidth, filtering and noise
- Fourier series and Fourier transform
- Information theory concepts: Nyquist's theorem, Shannon's theorem
- Analog and digital modulation techniques
- Communication systems circuits and devices
- Data encoding

- Physical layer protocols
- Data link control (point to point communication, design issues, link management, error control, flow control)
- Multiplexing and switching

PROG1101C: PROGRAMMING CONCEPTS
- Introduction to the basic programming concepts using a problem solving approach
- Writing Algorithms
- Definition of Source Code & Compiler
- Integrated Development Environments (IDEs)
- Data types & Variables
- Conditional Statements
- Arrays
- Loops
- Basic Input and Output System
- Functions/Methods: definition, passing parameters/arguments, return types
- Calling Methods
- Overview of packages & libraries

WAT1116C: INTERNET PROGRAMMING I
- Intro to Internet & WWW Concepts
- Intro to HTML5, XHTML
- Headings, Linking, Images
- Lists, Tables, Forms
- Internal Linking, meta Elements
- CSS3, Embedded Style Sheets, Positioning Elements, Element Dimensions, Box Model & Text Flow
- Drop Down Menu using CSS
- User Style Sheets
- Intro to JavaScript and JQuery
- JavaScript Control Statements
- JavaScript Functions, Arrays, Objects, Events

CAN 1101C: NETWORKS
- Overview of Networking
- Communications Model, ISO-OSI Reference Model, TCP/IP Suite
- Popular application layer protocols such as: HTTP, FTP, SMTP and DNS
- Transport Layer protocols: TCP and UDP
- Connection Management, Reliable Data Transfer, Flow Control, Error Control, Congestion Control
- Network Layer protocols: Ipv4 and IPv6, DHCP, ARP, RARP
- Fragmentation
- Network Design: Topologies
- Networking issues: Subnetting, NAT
- Networking Devices (Hubs, Switch, Bridge, Router,..) and Media

PROG1119C: OBJECT ORIENTED SOFTWARE DEVELOPMENT
- Introduction to object programming paradigm
- Object & Class Concepts
- Inheritance
- Interface and Polymorphism
- Casting
- Collection Classes
- Exception Handling
- Streams & File Manipulation

HCA1109C: COMPUTER AND MICROPROCESSOR ARCHITECTURE AND PROGRAMMING
- Introduction to computer architecture & organization: RISC /CISC, superscalar.
- Instruction Set Architecture:addressing modes and formats, data types, operands and operations.
- Computer Evolution & Performance: Moore's Law, CPI, benchmarking tools and standards. Buses, Interrupts, Memory: cache, internal & external, I/O and operating system support.
- Computer arithmetic: Floating point arithmetic, RPN, Boolean algebra. Logic
- Design: Logic Gates, K-Maps, MSI chips, Circuits and latches, Sequential Circuit design.
- Advanced CPU functions: pipelining, branch prediction, ILP, etc.
- Microprogramming (Assembly language program development environment and tools, Analysis and development of microprograms,
- Strandard program constructs: sequence, selection and iteration, Organising microprograms: assembler macros)

SDT1117C: ANALYSIS AND DESIGN
- Intro to Large Scale Systems development
- Software Life Cycles
- Structured techniques for Analysis & Design
- OO methodology – the RUP
- Object Oriented Analysis & Design with UML

WAT2117C: INTERNET PROGRAMMING II
- Architecture of internet-based applications (Client/Server model, 3-tier Model)
- Design and implementation of complete Internet-based applications
- Web-enabled databases
- Development of Multitiered web applications
- Components usage
- Server-side scripting (ASP.NET) to code business logic
- Survey of classes/types of web applications

OSS2110C: OPERATING SYSTEM ADMINISTRATION
- Building blocks of modern operating systems
- Process management, synchronisation, deadlocks
- Threading & parallel processing
- Memory management
- File management system
- Input/Output
- Virtualisation
- Mobile Operating Systems
- Administration of OS services Linux, and/or Windows

CAN2105C: SWITCHING TECHNIQUES
- Introduction to Switching and Networks,
- Ethernet
- Distributed Packet Switching for Local Computer Networks,
- Queueing in Networks,
- Single Stage Switching Systems,
- Multistage Switching Systems with Dynamic Routing,
- Multicast Switch Architectures with Dynamic routing (ATM Switch),
- Multistage Switching Systems with Static Routing,
- Unbuffered Switching Networks.

SECU2114C: DATA AND NETWORK SECURITY I
- Security services and mechanisms
- Common security threats and attacks
- Physical Security and Disaster recovery
- Authentication of users: Password, Smart card/Token, Biometrics
- Authorisation: Models, Access Control lists, Centralised & decentralised

- Use of symmetric cryptography in Security
- Kerberos for authentication and authorisation in networks
- Use of Public key cryptography, digital certificates and digital signatures for security
- Use of hash and MAC algorithm for security
- Quantum cryptographic protocol for key distribution
- Secure socket layer for web security.
- Security of ecommerce web sites

PROG2104C: VISUAL PROGRAMMING
- Visual programming paradigm;
- Comparative study with structured programming;
- Event-driven and object-driven;
- Visual programming Fundamentals;
- Human-Computer-Interaction issues;
- HCI Design principles (e.g Norman, User centered, etc);
- Design model, system model and user's model;
- Mapping and forcing functions;
- Feedback, affordance, etc;
- Menus and screen-based controls; file handling;
- Error trapping and handling;
- Validation;
- DB programming;
- Disconnected architecture;
- Datasets and data controls;
- Quality attributes to DB programming.

CAN2113C: NETWORK PROGRAMMING
- Based on Java Programming
- The Layers of a Network IP, TCP, and UDP, The Internet, The Client/Server Model, Internet Standards
- Web Concepts: URIs, HTML, SGML, and XML, HTTP, MIME Media Types, Server-Side Programs
- Streams: Output Streams, Input Streams, Filter Streams, Reader & Writers
- Threads: Running threads, Synchronisation, Deadlock, Thread Sheduling
- Looking Up Internet Address: The InetAddress Class, the NetworkInterface class
- URLs and URIs: URL and URI class, URLEncoder & Decoder, Proxies
- Sockets for clients, Sockets for Servers, Secure sockets
- UDP Datagrams and Sockets
- Multicast Sockets
- Remote Method Invocation

SECU3114C: DATA AND NETWORK SECURITY II
- Malware, Backdoor & Rootkits
- Email Security
- Web application vulnerabilties
- Firewall & Intrusion Detection systems
- IPSec and VPN
- Ethical Hacking concepts
- Wireless Network Security
- Different types of attack (Wardriving, SSID issues, eavesdropping, jamming, rogue access point,...)
- WI-FI protected access (WPA)
- Authentication, RADIUS, RSN, TKIP (Temporary Key Integrity protocol)
- Public Wireless Hotspots
- WEP, WEP Vulnerabilities
- Cross platform wireless user Security
- Introduction to Security for Mobile IPv6, Mobile Commerce
- SmartCard as a mobile security device

CAN2103C: COMMUNICATION & NETWORKING DESIGN AND MANAGEMENT
- Survey of the current technologies applicable to the development of corporate LAN, LAN to LAN   connection, LAN interconnection via WAN and mobile LAN.
- Analysis and design of corporate networks through case-studies.
- Managing network performance and security.
- Fault and configuration management in networks.

SEM3101C: RESEARCH AND INNOVATION SEMINAR
- Role of research & innovation in business
- Literature review
- Developing a research problem
- Justifying research projects
- Choosing a research method (case study, survey, experiment) for a specific problem
- Planning project – scope and schedule development
- Managing risk in research projects
- Implementation issues in research projects
- Sustaining innovation in business

MCT3101C: MOBILE AND PERVASIVE COMPUTING
- Wireless Wide Area Networks (Cellular Networks),
- Wireless LAN (IEEE 802.11),
- Wireless Personal Area Networks (Bluetooth)
- Wireless Sensor Networks.
- Context Aware Computing
- Developing Mobile Web Applications(HTML5, CSS3, Server Side Scripting)
- Developing Native Mobile Applications (possible platforms: Android SDK or Objective C or J2ME)

SCG3112C: ARTIFICIAL INTELLIGENCE
- Definition of Artificial Intelligence (AI)
- The Turing test
- Introducing the concepts of weak and strong AI
- Studying the history of AI
- Understanding the concept of rationality
- Studying the nature of different environments
- Analyzing the structure of various agent programs
- Introducing problem-solving agents
- Exploring different types search strategies
- Presenting propositional logic and first order logic and their applications
- Examining expert systems and their applications
- Programming of classical AI concepts using PROLOG language

SECU3122C: COMPUTER FORENSICS
- Understanding the importance of computer forensics
- Review of computer hardware
- Incident response for forensics
- The computer forensic process, data acquisition
- Analysis of FAT & NTFS file system for evidence recovery
- Live data capture, memory analysis
- Evidence from routers
- Email forensics

CAN3112C: EMERGING NETWORKS AND TECHNOLOGIES
- Semantic Web
- Web 2.0 Concept
- Introduction to P2P technologies: topologies, classes, and search techniques.

- Resource Discovery in P2P networks (Blind search, informed methods, routing indices,...)
- Ad-Hoc Wireless Networks, Mobile Ad-Hoc Networks (MANET), VANET
- Opportunistic Networks
- Wireless Sensor networks
- Virtualisation
- Grid & Cloud Computing: underlying principles
- Case study of some exisiting cloud
- Data Centres for cloud computing
- Big data: analysis & challenges
- Internet of Things (IoT)

PROJ3106: COMPUTER SCIENCE PROJECT
- Demonstration of core competencies acquired on the degree
- Demonstration of creative acumen, self-management and self-development skills
- Computer Science Project can be of the following type (extract from the Computer Science Project handbook)
    - Planning, design and management of an enterprise network.
    - Development of a software application involving
        - Network Security and/or Management e.g. Network Monitoring software; Encryption software; Network Protocol Analysers; Instant Messaging; Collaboration Tools; IP telephony; Cluster Computing; Streaming Multimedia; etc...
        - Ubiquitous devices such as mobile phones or PDAs
        - P2P networking e.g. file sharing
    - Developing real-time interactive applications such as a control system, or games e.g. Single-user application/game; Multi-user application/game using e.g. Bluetooth technology; etc...
    - Research based study supported by simulations.
    - Solving an IT problem using some algorithmic approach.