DCS
UNIVERSITY OF JAFFNA

BSc (Computer Science)

(For Direct-intake Computer Science Students)

Level–1S

Effective from the Academic Year: 2016/2017

Department of Computer Science
Faculty of Science
University of Jaffna
Sri Lanka

Developed in February 2018

Course Code:	**CSC101S3**		
Course Title:	**Foundations of Computer Science**		
Credit Value:	**03**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	45	**--**	**105**

Objectives:

Provide logical and mathematical foundations of computer science, and illustrate the use of formal languages in computer science

Intended Learning Outcomes:

- Describe the fundamentals of mathematical and logical aspects
- Outline the concepts of programming
- Illustrate the use of formal languages in computer science
- Explain basic computer network organisation

Course Contents:

- Fundamental organisation of computer hardware and software: Motherboard, I/O Peripherals, Expansion slots and cards, application software, arithmetic-logic unit, registers, central processing unit, memory, storage devices
- Theoretical foundations of sets: Basic notation, representations and examples, membership and subsets, operations on sets, Cartesian products, power sets, cardinality, infinite sets
- Introduction to relations and functions: Domain and range of a relation, one-to-one, one-to-many, many-to-one, inverse, reflexive, symmetric, transitive relations, into, onto, one-one, Bijective functions.
- Concepts of flowcharts and algorithms
- Introduction to propositional and predicate logic: Propositions, quantifiers, predicates, arguments
- Boolean algebra and logic gates: Combinatorial circuits, Boolean functions, Karnaugh map
- Number systems and their representations: Representation of integers and floating-point numbers in signed-magnitude and two's-complements
- Trees, Graphs and their applications: Graphs, representation of graphs, paths and circuits, planar graph, Binary trees, decision trees, tree traversal, spanning trees
- Automata, grammars and languages: Finite state machines, languages and grammars, language recognition, Turing machines
- Introduction to computer networks: Network topologies, transmission media and network devices, ISO OSI stack, IP addressing

Teaching/Learning Methods:

Use of chalkboard, Vocabulary drills, Flowcharts, Recitation oral questions, Timelines, Photographs, Tutorial discussions

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- B. A. Forouzan, Foundations of Computer Science, 3rd Ed., 2014.
- P. Norton, Introduction to Computers, 7th Ed., Tata McGraw Hill Education, 2011.
- R. L. Graham, Donald E. Knuth, and Oren Patashnik. Concrete Mathematics: Foundation for Computer Science, 2nd Ed., Addison-Wesley Professional, 1994.

Course Code:	**CSCI102S3**		
Course Title:	**Computer Programming I**		
Credit Value:	**03**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	--	**135**	**165**

Objectives:

Provide fundamentals of programming concepts in Java and introduce the concepts of object-oriented programming

Intended Learning Outcomes:

- Demonstrate fundamental programming concepts
- Identify classes, objects, members of a class and relationships among them needed for a specific problem
- Solve variety of computational problems
- Create programs using fundamental concepts of object-oriented programming

Course Contents:

- Interaction with a computer: Graphical user interface, command line interface, files and folders, using text editors / IDEs, programming principles
- Program development in Java: Programming principles, Edit-Compile-Run cycle, basic components of a Java program, syntax and semantics, data types, variables and constants, expressions, built-in classes
- Introduction to Object-Oriented Programming: Classes and objects, fields and methods, arguments and parameters, constructors, class and instance data values
- Control Flow: Sequence, selection, repetition, explicit control-flow statements
- Arrays and Collections: 1D & 2D Arrays, arrays of objects, for-each loop, passing arrays to methods, searching and sorting in arrays
- Concepts of recursion and backtracking: Recursion concepts, examples using recursion, recursion vs. iteration, recursive backtracking
- Implementing standard algorithms: String matching, counting coins, Knapsack problem, Huffman coding, activity-selection, scheduling problem
- Inheritance and Polymorphism: Principles of Inheritance, member accessibility, inheritance over accessibility, principles of polymorphism and polymorphic constructors/methods

Teaching/Learning Methods:

Laboratory experiments, Supervised study, Practical records, Tutorial discussions

Assessment Strategy:

- In-course Assessments
  - Assessment on practical records 10%
  - End-of-First Semester Practical Assessment 30%
- End-of-Second Semester Practical examination 60%

References:

- C. T. Wu, An Introduction to Object-Oriented Programming with Java, 5th Ed., McGraw-Hill Education, 2009.
- P. Deitel and H. Deitel, Java How to Program, 9th Ed., Pearson Education, Inc., 2012.
- H. Schildt, Java: The Complete Reference, 9th Ed., McGraw-Hill Osborne Media, 2014.

Course Code:	**CSC103S3**		
Course Title:	**Introduction to Computer Systems**		
Credit Value:	**03**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	**30**	**90**

Objectives:

Provide the students a conceptual level understanding of the structure and operation of computers and the Internet. In addition, this course also provides a basic understanding on threats to computer systems and computer networks

Intended Learning Outcomes:

- State the conceptual and physical structure of a computer
- Describe the operation of a computer system and the components
- Demonstrate the structure and operations of the Internet
- Troubleshoot a computer for hardware and software related issues

Course Contents:

- Conceptual design and operation of modern computers: Data and Information, Conceptual design of modern computers (John von Neumann) and stored program concept, CPU and memory organisation, execution of programmes, Booting process, digital storage devices
- Basics of the Internet: Structure of the Internet, Operation of Internet – TCP IP, IP Addressing, Domain naming system, Role of servers and clients, Management and control of the Internet – ISP, Internet Consortium
- Internet services and applications: WWW, e-mail, e-learning, Social Networking, Blogs, Cloud computing
- Threats to computer systems and information: Computer malware, ways to protect computer systems from malware, securing information - encryption technique, digital signature, biometric devices, email filtering, firewall, and precautions on Web; prevention of electronic theft
- Computer related ethical issues: copyright, software licenses, information privacy, intellectual property, content filtering, Spam, and laws enacted with regards to SPAM, protecting web and electronic communication from antisocial and anti-cultural elements
- Maintaining Computer hardware and software: Servicing a computer, installing operating systems and configuring a computer, installing software and drivers, troubleshooting computers, setting up a computer network

Teaching/Learning Methods:

Lectures, Workshop sessions, Visit to Network Operating centre, Tutorial discussions

Assessment Strategy:

- In-course Assessment (Theory) 15%
- In-course Assessment (Practical) 15%
- End-of-course Examination 70%

References:

- P. Norton, Introduction to Computers, 7th Ed., Tata McGraw Hill Education Private Limited, 2011.
- R. White and T.E. Downs, "How Computers Work", 3rd Ed., 2008.

Course Code:	**CSC104S2**		
Course Title:	**Mathematics for Computing I**		
Credit Value:	**02**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	**--**	**70**

Objectives:

Provide fundamental mathematical concepts and techniques in finding the solution methods for real world problems and then to apply those techniques for the proposed solutions by a computer

Intended Learning Outcomes:

- Apply proof techniques in the construction of a sound argument
- Perform the operations associated with sets
- Analyse connections between various types of relations
- Classify various types of functions
- Illustrate the use of Boolean algebra in logic circuit designs

Course Contents:

- Proof Techniques: Notions of implication, equivalence, converse, inverse, contrapositive, negation, and contradiction. Direct proofs, Disproving by counterexample, Proof by contradiction
- Set theory: Venn diagrams, set operations, Cartesian product, Power sets, Cardinality of finite sets
- Relations and functions: Reflexivity, symmetry, transitivity of relations, Equivalence relations, partial orders; Surjections, injections, bijections; Inverses, Composition of functions
- Boolean algebra: Introduction, Duality, Representation theorem, Sum-of-products from Boolean algebra

Teaching/Learning Methods:

Lectures, class discussions, textbook assignments

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- S. Lipschutz, "Set theory and related topics", McGraw-Hill, 1998.
- R. R. Stoll, "Set theory and logic", 1979.

Course Code:	**CSC105S3**		
Course Title:	**Statistics for Computing I**		
Credit Value:	**03**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	45	**--**	**105**

Objectives:

Provide a solid theoretical foundation of Statistics with a combination of experience in solving real world problems with a computer

Intended Learning Outcomes:

- Describe the concepts of probability
- Apply Bayes' Theorem
- Utilise the probability distributions for real world problems
- Describe the concept of Random variable

Course Contents:

- Introduction to probability: Permutations, combinations, Venn diagram, events, sample space, mutually exclusive events, axioms of probability, laws of probability, conditional probability, independence
- Bayes' Theorem and Applications: Partition, total probability theorem, Bayes' theorem, tree diagram
- Random variable: Discrete and continuous random variables, probability mass function, probability density function, expectation, moments, mean and variance, moment generating functions, probability generating functions
- Probability distribution: Discrete uniform, Bernoulli, binomial, Poisson, geometric, uniform, exponential and normal distributions, applications of the normal distribution, sampling distribution of the sample means
- Joint distributions: Joint distributions, marginal distribution, conditional distributions, conditional expectation and variance

Teaching/Learning Methods:

Lectures, class discussions, textbook assignments, Guided learning

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- S. Ghahramani, "Fundamentals of Probability", 2004.
- M. R. Spiegel, "Probability Schaum's Outline Series", 2000.

Course Code:	CSC106S3		
Course Title:	Human Computer Interaction		
Credit Value:	03		
Core/Optional:	Core		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	30	90

Objectives:

Introduce principles and methods to build effective computer interfaces for users

Intended Learning Outcomes:

- Explain the fundamental theories of Human Computer Interaction (HCI), key features of interaction and common interaction styles.
- Evaluate heuristic user interfaces by using a variety of analysis and design methods
- Apply user-centered and contextual design techniques for human computer interface design scenarios
- Implement a prototype of a user interface for a system that satisfies usability requirements
- Discuss the design of HCI in various recent developments

Course Contents:

- **Foundations of Human Computer Interaction (HCI) and the Design Process:** Human Capabilities, Interaction Design Basics, HCI in the Software Process, Design Rules, Universal Design, The Human Body and Device Design
- **Human Cognition and Interaction Styles:** Goals, Operators, Methods, and Selection (GOMS), Keystroke-Level Modelling, Time-scales and the Illusion of Multitasking, Metaphor, Direct Manipulation, Command Languages
- **Usability Engineering:** Observing Users, Usability Analysis - Error Handling, Error Prevention, Cognitive Walkthroughs, Heuristic Evaluation, Usability Guidelines, Usability Methods; Prototyping, Task Analysis, User-Centred Design
- **User Interface Programming:** Interface Implementation, Events and Handlers, Development Tools
- **Recent Development in HCI:** Groupware, Ubiquitous Computing, Virtual and Augmented Realities, Hypertext and Multimedia

Teaching/Learning Methods:

Lectures, Modelling in various media, Construction of diagrams, Case studies

Assessment Strategy:

- In-course Assessments (Theory) 15%
- In-course Assessments (Practical) 15%
- End-of-course Examination 70%

References:

- H. Sharp, Y. Rogers, and J. Preece. Interaction Design: Beyond human-computer interaction, 4th Ed., Wiley Publishers, 2015.
- B. Shneiderman, C. Plaisant, M. Cohen and S. Jacobs. Designing the User Interface: Strategies for Effective Human-Computer Interaction, 5th Ed., Addison Wesley publishers, 2010.

Course Code:	**CSC107S2**		
Course Title:	**Multimedia Technologies**		
Credit Value:	**02**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	**--**	**70**

Objectives:

Provide in-depth knowledge in technologies to develop multimedia-based contents

Intended Learning Outcomes:

- Explain the fundamental principles of multimedia
- Demonstrate compression techniques used in multimedia
- Discuss theories behind the multimedia components
- Design contents using multimedia technologies

Course Contents:

- Introduction: Uses of multimedia, interaction technologies, multimedia hardware and devices
- Compression techniques in multimedia: compression basics, lossless and lossy compression techniques
- Text in multimedia: Visual representation of text, digital representation of characters
- Fundamentals of colours, colour models and dithering
- Fundamentals of images: characteristics of images, image file formats, and image compression standards
- Digital audio: sound processing, representation of audio files
- Fundamentals of video and animation: analogue and digital video standards, video processing, video compression standards and file formats, basics of animation
- Designing multimedia contents: Development phases, multimedia authoring and tools, multimedia in the internet

Teaching/Learning Methods:

Lectures, recitation of oral questions, use of chalkboard and multimedia presentations

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- Z.N. Li and M.S. Drew, "Fundamentals of Multimedia", 2nd Ed., 2014.
- A. Banerji; A. M. Ghosh, "Multimedia technologies", 2010.
- T.M. Savage and K.E. Vogel, "An Introduction to Digital Multimedia", 2nd Ed., 2013.

Course Code:	**CSC108S2**		
Course Title:	**Design of Algorithms**		
Credit Value:	**02**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	**--**	**70**

Objectives:

Provide in-depth knowledge in different algorithmic approaches for problem solving

Intended Learning Outcomes:

- Demonstrate familiarity of various algorithm design techniques and their applications
- Use different strategies to compare the performance of algorithms
- Discuss the usages of different Iterative and recursive algorithms
- Apply different algorithmic approaches and concepts for solving computational problems

Course Contents:

- Algorithm Analysis: Informal comparison of algorithm efficiency, best, expected, and worst case behaviours, time and space trade-offs in algorithms, Asymptotic analysis (big O, little o, big Ω and big Θ notations)
- Problem-solving strategies: Iterative and recursive algorithms
- Brute-force and Greedy methods: Concepts of Brute-force and Greedy methods, applications of Brute-force and Greedy methods for solving problems (String matching, counting coins, Knapsack problem, Huffman Coding, Activity-selection, Scheduling problems)
- Searching and sorting in arrays and their complexities: Linear search, binary search, selection sort, insertion sort, bubble sort

Teaching/Learning Methods:

Lectures, class discussions, textbook assignments, laboratory practical

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- T. Cormen, C. Leiserson, R. Rivest, C. Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.
- R. Sedgewick and K. Wayne, Algorithms, 4th Ed., Addison Wesley Publishers, 2011.

Course Code:	CSC109S2		
Course Title:	Introduction to Computer Security and Cryptography		
Credit Value:	02		
Core/Optional:	Core		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	--	70

Objectives:

Introduce Computer security principles and cryptography, and analyse the need of Public key infrastructure and its applications

Intended Learning Outcomes:

- Describe the concepts of computer security and cryptography
- Explain notions of threat, vulnerability, and attacks
- Utilise different symmetric key and public key encryption algorithms
- Discuss the importance of Public key Infrastructure and its applications

Course Contents:

- Foundations of computer security: introduction to computer security and cryptography
- Concepts of risks, threats, vulnerabilities and types of attacks: computer security attacks, types, attacker goals, motivations (such as underground economy, digital espionage, cyberwarfare, insider threats, hacktivism, advanced persistent threats), examples of malware, organizational vulnerabilities and threats
- Key security properties: confidentiality, integrity and availability
- Concepts of authentication, authorization and access control: OSI security architecture, security services and security mechanisms
- Classical encryption techniques: Symmetric key ciphers, substitution techniques, transposition techniques, other classical encryption tools, key management techniques
- Public-key cryptography and its applications: introduction to PKI, hash functions, digital signatures and digital certificates, secure web browsing, e-commerce, secure authentication

Teaching/Learning Methods:

Lectures, Class discussion, Recitation oral questions, Lecture demonstration, Small group discussions,
Use of slides, Textbook assignments.

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- W. Stallings, Cryptography and Network Security: Principles and Practice, 6th Ed., 2013.
- J. Katz and Y. Lindell. Introduction to Modern Cryptography, 2nd Ed., 2014.

Course Code	**CSCI110S2**		
Course Title	**Organisational Behaviour**		
Credit Value:	**02**		
Core/Optional:	**Core**		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	**--**	**70**

Objectives:

Provide students with an awareness of the concept of organisational behaviour and determinants of human behaviour in organisation

Intended Learning Outcomes:

- Identify individual level, group level and organizational level factors which influence human behaviour at work
- Describe the ways of developing personality, changing attitudes and motivating employees
- Define leadership theories, communication skills and change management approaches
- Outline the stress and conflict management techniques

Course Contents:

Introduction to organisational behaviour, personality, values, attitudes, perception, learning and reinforcement, motivation in the workplace setting, group and interpersonal process, foundations of leadership, conflict and negotiation, essentials of interpersonal communication, organisational change management

Teaching/Learning Methods:

Lectures, guest lectures, class discussions, small group discussions, case studies

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- F. Luthans, Organisational Behaviour, 12th Ed., 2010.
- J.W. Newstrom and K. Davis, Organisational Behaviour: Human Behaviour at Work, 2004.
- L.J. Mullins, Organisational Behaviour, 11th Ed., 2013.

Course Code	CSC1111S2		
Course Title	Mathematics for Computing II		
Credit Value:	02		
Core/Optional:	Core		
Hourly Breakdown:	Theory	Practical	Independent Learning
	30	--	70

Objectives:

Provide a solid foundation of Mathematics to apply them to solve problems in Computer Science

Intended Learning Outcomes:

- Describe basic properties of integers
- Use Euclid's algorithm
- Solve systems of linear congruences
- Describe basics of finite group theory

Course Contents:

- Number theory: Introduction, integers, factors and Euclid's algorithm, unique factorization, linear congruences, Inverses, Chinese remainder theorem, Fermat's Theorem.
- Group theory: Definitions and examples, order of elements, subgroups, cosets and Lagrange's theorem, cyclic groups.

Teaching/Learning Methods:

Lectures, class discussions, textbook assignments

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- D. Burton, "Elementary Number Theory", 2010.
- J.B. Fraleigh, "A First course in abstract algebra", 2002.
- G.A. Jones and J.M. Jones, "Elementary number theory", Springer, 1998.
- B. Baumslag and B. Chandler, "Group Theory", 1968.

Course Code	CSCI12S3		
Course Title	Statistics for Computing II		
Credit Value:	03		
Core/Optional:	Core		
Hourly Breakdown:	Theory	Practical	Independent Learning
	45	--	105

Objectives:

Train students in applying statistical methods in proposing solutions for real world problems to be solved with computer.

Intended Learning Outcomes:

- Examine data using summary statistics and graphical methods
- Outline different methods of parameter estimation in Statistics
- Discuss the principles of hypothesis testing with applications
- Apply simple linear regression technique to real world issues

Course Contents:

- Descriptive Statistics: Types of data, population, sample, parameter, statistic, tabular and pictorial presentation of data, summary statistics, measures of central tendency and dispersion, skewness, kurtosis
- Point and Interval Estimation: Sampling distributions, central limit theorem, confidence intervals for one-sample, two–sample population characteristics, sample size calculation for parameter estimation, interpretation of confidence intervals
- Testing Hypotheses: Steps in hypothesis testing, level of significance, Type–I and Type–II errors,
- p–value, power of test, Z–test, t –test, χ^2 test, and F-test, goodness of fit test
- Simple linear regression: Correlation, simple linear regression, least square estimation, interpretation of regression parameters, application of simple linear regression

Teaching/Learning Methods:

Lectures, Tutorial discussions, Guided Learning

Assessment Strategy:

- In-course Assessments 30%
- End-of-course Examination 70%

References:

- D.S. Moore, G.P. McCabe and B. Craig, Introduction to the Practice of Statistics, 6th Edition, 2009.
- R.E. Walpole, R.H. Myers, S.L. Myers, K.E. Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, 2010.
- S.A. Lesik, "Applied Statistical Inference with Minitab", 2009.