



Information and Communication Technology

Syllabus

Grades 12 and 13

(Effective from 2017)

**Department of Information Technology
National Institute of Education
Maharagama
Sri Lanka**

www.nie.lk

**Information and Communication Technology
Grade 12 and 13 - syllabus**

**©National Institute of Education
first print 2017**

ISBN:

**Department of Information Technology
Faculty of Science and Technology
National Institute of Education
Maharagama**

www.nie.lk

Printed by:

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1.0 Introduction

Information and Communication Technology has been identified worldwide as a tool that can be used to improve productivity, efficiency and effectiveness of organizational work and the daily activities of individuals. Therefore, providing an adequate level of ICT knowledge and skills, at different levels of education, is important for the students to progress and contribute towards national development.

The current Sri Lankan Secondary Education System has been substantially exposed to ICT through various programs including CAL, ICT for GCE (O/L), GIT at grade 12 and ICT as a component in A/L Technology stream. Consequently, students have shown a growing interest in ICT education and some have, in fact, performed excellently at international competitions in ICT, proving their high level of competence.

ICT as a main subject for GCE (A/L) was introduced in 2007. The syllabus was revisited in 2013. According to the syllabus revising policy the syllabus was revised in 2017. GCE (O/L) qualified students who are interested in developing their career path in ICT, have the opportunity of learning it at the GCE (A/L). ICT as a subject for A/L would set a national standard in ICT education at school level and provide the path to higher education at tertiary level. Furthermore, students who fail to earn a placement in a university would be in possession of a substantial foundation to build up their academic and professional careers.

The ICT syllabus at GCE (A/L) communicates core concepts of ICT covering both theoretical and practical usage of ICT. This will also strengthen student's awareness of the new trends and future directions of ICT. Also this subject will provide an added advantage to students by improving their soft skills, thereby enabling them to best fit into working environments.

2.0 National Goals

1. Based on the concept of respecting human values and understanding the differences between the Sri Lankan multi-cultural society, building up the nation and confirming the identity of Sri Lanka by promoting national integrity, national unity, national coherence and peace
2. While responding to the challenges of the dynamic world, identifying and conserving the National heritage.
3. Creating an environment which comprises of the conventions of social justice and the democratic life to promote the characteristics of respecting the human rights, being aware of the responsibilities, concerning each other with affectionate relationships.
4. Promoting a sustainable life style based on the people's mental and physical well-being and the concept of human values
5. Promoting the positive feelings needed for balanced personality with the qualities of creative skills, initiative, critical thinking and being responsible
6. Through education, developing the human resources, needed for the progress of the well-being of an individual, the nation as well as the economic growth of Sri Lanka.
7. Preparing the people for the changes that occur in a rapidly changing world by adapting to it and controlling them; developing abilities and potentialities of people to face the complex and unexpected occasions.
8. Sustaining the skills and attitudes based on justice, equality, mutual respect which is essential to achieve a respectable place in the international community.

National Education Commission Report (2003).

3.0 Basic Competencies

The competencies promoted through the education mentioned below might help to achieve the above mentioned National Goals.

1. Competencies in Communication

This first set of competencies is made up of four subsets - Literacy, Numeracy, Graphics and information communication skills:

Literacy: Carefully listening, speaking clearly, and Reading for comprehension, writing clearly and accurately.

Numeracy: Using numbers to count, calculate, code and to measure, matter, space and time

Graphics: Making sense of line and form, expressing and recording essential data, instructions and ideas with line, form, colour, two and three-dimensional configurations, graphic symbols and icons

ICT Competencies:

Knowledge on computers, and the ability to use the information communication skills learning or work as well as in the private life

2. Competencies relating to the Personality Development

- Generic skills such as creativity, divergent thinking, initiative, decision making, problem-solving, critical and analytical thinking, team work, inter-personal relationships, discovering and exploring
- Values such as integrity, tolerance and respect for human dignity
- Cognition

3. Competencies relating to the Environment

This is the second set of competencies related to the Social, Biological and Physical Environments.

Social Environment: Awareness, sensitivity and skills linked to being a member of society, social relationship, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations.

Biological Environment: Awareness, sensitivity and skills linked to the living world, man and the ecosystem, the trees, forests, seas, water, air and plant-life, animal and human life.

Physical Environment: Awareness, sensitivity and skills relating to space, energy, fuels, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, wastes and excretion, media of communication and transport.

Included here are the skills in using tools to shape and for materials for living and learning

4. Competencies relating to preparation for the world of work

Employment related skills to maximize their potential and to enhance their capacity to contribute to economic development; to discover their vocational interests and aptitudes; to choose a job that suits their abilities and to engage in a rewarding and sustainable livelihood.

5. Competencies relating to religion and ethics

This fourth set of competencies laden with values and attitudes. It is essential for individuals to assimilate values, so that they may function in a manner consistent with the ethical, moral and religious modes of conduct, rituals, practices in everyday living, selecting the most appropriate.

6. Competencies in play and use of leisure

Competencies that link up with pleasure, joy, emotions and such human motivations. These find expression in play, sports, athletics and leisure pursuit of many types. These also link up with such values as cooperation, team work, healthy competition in life and work. Here are included such activities as are involved in aesthetics, arts, drama, literature, exploratory research and other creative modes in human living.

7. Competencies relating to 'Learning to learn'

These competencies flow directly from the nature of a rapidly changing, complex and interdependent and crowded world whatever one learns, that learning will need updating and review. This requires that one should be aware of, sensitive and skilful in sustained attention, and be willing to persevere and attend to details that matter in a given situation.

4.0 Objectives of the Subject

This syllabus enables students to:

- Establish the foundation for ICT education leading to higher education
- Establish the foundation to build up their professional career
- Produce entry level ICT human resources required for the industry
- Enable to use ICT effectively in achieving Sustainable Development Goals (SDG)
- Provide students with ICT knowledge to improve the quality of life in general
- Provide awareness of the importance of computer networking for communication
- Improve the skills required for the development of ICT based solutions for real world problems
- Provide awareness of the new trends and future directions of ICT
- Enable to use ICT for innovation and researches
- Develop an appreciation of the role of ICT in a knowledge-based society

5.0 Basic Competencies Mapping

No	Basic Competencies	Units
1	Competencies in Communication	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
2	Competencies relating to the Personality Development	3, 8, 9, 12
3	Competencies relating to the Environment	
	Social Environment	7, 11
	Biological Environment	12
	Physical Environment	2, 3,7
4	Competencies relating to preparation for the world of work	6, 8, 9, 10
5	Competencies relating to religion and ethics	6
6	Competencies in play and use of leisure	11
7	Competencies relating to 'Learning to learn'	2, 4, 8, 6, 9, 10

6.0 Proposed number of periods for each units

No	Units	No. of periods
1	Concept of ICT	28
2	Introduction to Computer	22
3	Data Representation	18
4	Fundamental of Digital Circuits	26
5	Computer Operating System	22
6	Data Communication and Networking	50
7	System Analysis and Design	68
8	Database Management	50
9	Programming	74
10	Web Development	60
11	Internet of Things	15
11	ICT in Business	12
12	New trends and Future Directions of ICT	12
13	Project	30

Competency	Competency Level	Contents	Learning outcomes	Periods
Competency 1: Explores the basic concepts of ICT together with its role and applicability in today's knowledge based society	1.1 Investigates the basic building blocks of information and their characteristics	<ul style="list-style-type: none"> • Life cycle of data <ul style="list-style-type: none"> ○ Data creation ○ Management ○ Removal of obsolete data • Data vs. Information • Definition of information • Characteristics of valuable information: timeliness, accuracy, presented within the context, enhanced understandability and less uncertainty • The need to handle large volumes and other complexities of data <ul style="list-style-type: none"> - Introduction 	<ul style="list-style-type: none"> • Defines data and outlines its life cycle • Recognizes the need of a process to define data and information • Recognizes the strong inter relationship between data, process and information • Describes data, process and information • Lists various forms of data and their characteristics • Describes the characteristics of quality data • Distinguishes data from information • Illustrates the value of information • Describes the characteristics of valuable information • Recognizes big data, their needs and analysis 	6
	1.2 Investigates the	<ul style="list-style-type: none"> • Applicability of information in day to 	<ul style="list-style-type: none"> • Identifies the 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
	<p>need of technology to create, disseminate and manage data and information</p>	<p>day life</p> <ul style="list-style-type: none"> ○ Decision making ○ Policy making ○ Predictions ○ Planning, scheduling and monitoring <ul style="list-style-type: none"> ● Drawbacks of manual methods in manipulating data and information <ul style="list-style-type: none"> ○ Inconsistency and duplication in data, room for errors, human errors and delay in processing ○ Lack of sharing information and reduced customer services ● Infeasibility of applying manual methods where they can be harmful to humans ● Emergence of ICT era <ul style="list-style-type: none"> ○ Use of IT to overcome the drawbacks of manual methods of data manipulation ● Usage of information in various domains ● Availability of technologies related to information retrieval and sharing ● Development of computer networks, the Internet and WWW ● Development of mobile communication, mobile computing and cloud computing 	<p>drawbacks of manual data processing methods</p> <ul style="list-style-type: none"> ● Describes the importance of information in day to day life ● Lists the available technologies related to information dissemination ● Investigates the development of computer networks, the Internet and WWW ● Describes the development of mobile communication, mobile computing and cloud computing ● Appreciates the use of technology to create, disseminate and manage, data and information ● Recognizes the usage of information in various domains ● Investigates the 	

Competency	Competency Level	Contents	Learning outcomes	Periods
			safety issues of human operators in various applications	
	1.3 Formulates an abstract model of information creation and evaluates its compliance with ICT	<ul style="list-style-type: none"> • Abstract model of information creation <ul style="list-style-type: none"> ○ Input, process, output ○ Its appropriateness to Computer and ICT 	<ul style="list-style-type: none"> • Identifies the components of an abstract model of information creation • Defines a system • Analyses various systems using the system definition • Relates the abstract model to information systems • Matches the abstract model of information creation to the main functions of the computer • Recognizes the role of ICT in the abstract model of information creation 	2
	1.4 Selects and classifies the basic components of a computer system	<ul style="list-style-type: none"> • Hardware <ul style="list-style-type: none"> ○ Classification of hardware components • Software <ul style="list-style-type: none"> ○ Classification of software • Human Operators <ul style="list-style-type: none"> ○ Need of human operators in 	<ul style="list-style-type: none"> • Defines and classifies hardware and software components • Distinguishes proprietary software and open source 	2

Competency	Competency Level	Contents	Learning outcomes	Periods
		information systems	software <ul style="list-style-type: none"> • Describes the advantages and disadvantages of proprietary and open source software • Identifies the role of human operators in the ICT enabled information systems 	
	1.5 Analyses the activities of data processing	<ul style="list-style-type: none"> • Steps in data processing: <ul style="list-style-type: none"> ○ Data gathering ○ Data validation ○ Data processing ○ Data output ○ Data storage • Data gathering methods <ul style="list-style-type: none"> ○ Manual methods ○ Semi-automated and automated methods • Tools - (OMR, OCR, MICR, card/tape readers, magnetic strip readers, bar code readers, sensors and loggers) • Data validation methods <ul style="list-style-type: none"> ○ Data type check ○ Presence check ○ Range check • Modes of data input <ul style="list-style-type: none"> ○ Direct and remote ○ Online and offline 	<ul style="list-style-type: none"> • Lists and briefly describes the data processing steps • Identifies data gathering methods • Identifies data validation methods • Lists data input methods • Describes data processing methods • Lists data output methods • Describes data storage methods 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> • Data processing <ul style="list-style-type: none"> ○ Batch and real time • Output methods <ul style="list-style-type: none"> ○ Direct presentation to the user ○ Storing for further processing • Storage methods • Local and remote storage (cloud) • Short and long term storage 		
	1.6 Investigates the application of ICT in different domains	<ul style="list-style-type: none"> • Application of ICT in: <ul style="list-style-type: none"> ○ Education ○ Healthcare ○ Agriculture ○ Business and finance ○ Engineering ○ Tourism ○ Media and journalism ○ Law enforcement 	<ul style="list-style-type: none"> • Identifies appropriate tools, skills and knowledge needed in different application domains • Discusses the benefits of ICT in different domains 	4
	1.7 Evaluates the impact of ICT in the society	<ul style="list-style-type: none"> • Benefits caused by ICT <ul style="list-style-type: none"> ○ Social benefits ○ Economic benefits • Issues caused by ICT <ul style="list-style-type: none"> ○ Social ○ Economical ○ Environmental ○ Ethical ○ Legal ○ Privacy ○ Digital divide • Confidentiality • Stealing / Phishing • Piracy 	<ul style="list-style-type: none"> • Explains the benefits of ICT in terms of social and economic aspects • Explains briefly the issues caused by advancement of ICT in terms of social, economic, environmental, ethical and legal aspects • Investigates the legal situation 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> • Copyright / intellectual property laws • Plagiarism • Licensed / unlicensed software 	<p>connected with the usage of ICT</p> <ul style="list-style-type: none"> • Explains the environmental issues associated with ICT • Explains safe disposal methods of e-waste • Explains briefly the ethical, Legal and social issues in the usage of ICT • Briefly explains the role of ICT in achieving Sustainable Development Goals (SDGs) • Investigates the approaches to eliminate digital divide 	
<p>Competency 2: Explores the evolution of computing devices, so as to be able to describe and</p>	<p>2.1 Elicits the significant changes occurred in the computers from generation to generation with more emphasis on the evolution of processors</p>	<ul style="list-style-type: none"> • History of computing <ul style="list-style-type: none"> ○ Early calculating aids <ul style="list-style-type: none"> ❖ mechanical ❖ electromechanical ○ Electronic age of computing • Generation of computers <ul style="list-style-type: none"> ○ 1G, 2G, 3G, 4G and future 	<ul style="list-style-type: none"> • Categorizes the early calculating aids with examples • Describes the generations of computers with their features in a table 	<p>4</p>

Competency	Competency Level	Contents	Learning outcomes	Periods
compare the performance of modern computers		<ul style="list-style-type: none"> • Different types of classifications <ul style="list-style-type: none"> ○ Technology <ul style="list-style-type: none"> ❖ analog, digital ○ Purpose <ul style="list-style-type: none"> ❖ special /general ○ Size <ul style="list-style-type: none"> ❖ super, mainframe, mini, micro (mobile devices –smart phones, tablet devices and phablets) 	<ul style="list-style-type: none"> • Categorizes computers in terms of technology, purpose and size with examples 	
	2.2 Explores the functionality of a computer in relation to the hardware and their interfaces	<ul style="list-style-type: none"> • Major hardware components <ul style="list-style-type: none"> ○ Input devices: keyboard entry and direct entry (keyboard, pointing devices, touch pad, remote control, touch screen, magnetic strip reader, barcode reader, smart card reader, scanner, digital camera, microphone, sensors, graphic tablets, MICR, OMR and OCR readers, video camera, digitizer, web cam) • Advantages of direct entry input devices over keyboard entry input devices • Output devices and their features (CRT monitor, TFT monitor, LED monitor, dot matrix printer, inkjet printer, laser printer, 3D printer, graph plotter, speakers) • CPU and its compatibility with motherboard • Storage devices(fixed internal hard 	<ul style="list-style-type: none"> • Identifies hardware peripherals and their relevant interfaces • Identifies the advantages of direct entry input devices over keyboard entry input devices • Describes the evolution of CPU and its compatibility with motherboard • Categorizes the Storage devices • Briefly explains the features of each storage device • Identifies the need for parallel and grid computing 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
		disk, portable external hard disk, magnetic tape, Optical discs(CD Rom/DVD Rom, CD-R/DVD-R, CD-RW/ DVD-RW, DVD-RAM, Blu-Ray) flash memory card, mini disk) <ul style="list-style-type: none"> • Parallel and grid computing 		
	2.3 Explores the Von-Neumann Architecture	<ul style="list-style-type: none"> • Von-Neumann Architecture <ul style="list-style-type: none"> ○ Stored program control concept ○ Components (input, output, memory, Processor control unit and processing ALU unit) • Fetch-execute cycle • Central processing unit (CPU) <ul style="list-style-type: none"> ○ Arithmetic and logic unit (ALU) ○ Control unit (CU) ○ Memory (Registers) ○ Data and control bus ○ Multi-core processors 	<ul style="list-style-type: none"> • Describes the stored program concept • Names the major components of Von-Neumann architecture • Describes fetch-execute cycle • Briefly describes ALU, CU, Memory (Registers), data and control bus • Draws the Von-Neumann Architecture model and names its components • Describes the need of multi-core processors 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
	2.4 Examines PC memory system to identify different types of memory and their main characteristics	<ul style="list-style-type: none"> • Memory hierarchy <ul style="list-style-type: none"> ○ Need of memory hierarchy ○ Comparison criteria <ul style="list-style-type: none"> ❖ Physical size / density of data ❖ Access method ❖ Access time (elapsed time/delay) ❖ Capacity ❖ Cost • Volatile memory and their characteristics <ul style="list-style-type: none"> ○ Registers ○ Types of cache memory ○ Main memory – RAM ○ Types of RAM <ul style="list-style-type: none"> ❖ SRAM, DRAM, SDRAM • Non-volatile memory and their characteristics <ul style="list-style-type: none"> ○ Types of ROMs <ul style="list-style-type: none"> ❖ PROM, EPROM and EEPROM ○ Secondary storage <ul style="list-style-type: none"> ❖ magnetic, optical and flash memory 	<ul style="list-style-type: none"> • Briefly explains the memory hierarchy with a suitable diagram • Describes the need for different types of memory and their characteristics • Briefly explains the volatile and non-volatile memory • Lists volatile and non-volatile memories in computer • Describes the characteristics of memory in terms of performance, location, capacity, access method, cost, physical type and physical arrangement of data (bits into words) • Lists and briefly explains the types and characteristics of ROMs • Compares and contrasts each type of memory in terms 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			of access time, cost / MB, capacity (typical amount used)	
Competency 3: Investigates how instructions and data are represented in computers and exploit them in arithmetic and logic operations	3.1 Analyses how numbers are represented in computers	<ul style="list-style-type: none"> • Need for instruction and data representation in digital devices • Methods of instruction and data representation in computers <ul style="list-style-type: none"> ○ Representation of data in two states (0,1) • Number systems used in computing <ul style="list-style-type: none"> ○ Binary, octal, hexadecimal ○ Conversion between number systems • Representation of decimal numbers (signed and unsigned) <ul style="list-style-type: none"> ○ Signed integer representations <ul style="list-style-type: none"> ❖ Signed magnitude ❖ One's complement ❖ Two's Complement 	<ul style="list-style-type: none"> • Describes that instruction and data are represented using two states in computers • Explains the need of different number systems • Describes how different types of decimal numbers are stored in computers • Converts decimal integers into binary, octal and hexadecimal numbers and vice versa • Converts binary numbers to octal and hexadecimal, and vice versa • Converts octal numbers to binary and hexadecimal, and vice versa 	10

Competency	Competency Level	Contents	Learning outcomes	Periods	
			<ul style="list-style-type: none"> Explains that the MSB is used to indicate the sign when converting the given binary value to one's complement Converts the given binary value to two's complement Explains the usage of one's complement and two's complement 		
	3.2	Analyses how characters are represented in computers	<ul style="list-style-type: none"> Methods of character representation <ul style="list-style-type: none"> BCD EBCDIC ASCII Unicode 	<ul style="list-style-type: none"> Lists the methods of character representation in computer Converts given symbols into a representation scheme Describes the advantage and disadvantage of different data representation schemes 	4
	3.3	Uses basic arithmetic and logic operations on binary numbers	<ul style="list-style-type: none"> Binary arithmetic operations - (integers only) <ul style="list-style-type: none"> Addition, subtraction Logical operations 	<ul style="list-style-type: none"> Works out additions (multiple numbers with or without carryovers) – in 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ○ Bitwise logical operations 	<ul style="list-style-type: none"> binary numbers • Works out subtraction (with or without borrowing) – in binary numbers • Works out NOT, AND, OR, XOR bitwise operations 	
Competency 4: Uses logic gates to design basic digital circuits and devices	4.1 Analyzes basic digital logic gates in terms of their unique functionalities	<ul style="list-style-type: none"> • Digital logic gates and truth tables <ul style="list-style-type: none"> ○ Basic logic gates <ul style="list-style-type: none"> ❖ NOT, AND, OR, and XOR ○ Combinational gates <ul style="list-style-type: none"> ❖ NAND, NOR, and XNOR ○ Universal gates <ul style="list-style-type: none"> ❖ NAND, NOR 	<ul style="list-style-type: none"> • Names basic logic gates and draws the appropriate symbols of them • Draws the truth tables for the basic logic gates • Identify symbols that represent negations of basic logic gates • Creates truth tables for given expressions (maximum three inputs) • Explains the need of universal gates • Explains the fabrication of any gate using universal gates 	6
	4.2 Simplifies logic	<ul style="list-style-type: none"> • Two state logic and Boolean Algebra 	<ul style="list-style-type: none"> • Describes the need 	8

Competency	Competency Level	Contents	Learning outcomes	Periods
	expressions using laws of Boolean algebra and Karnaugh map	<ul style="list-style-type: none"> • Postulates (Axioms) • Laws/theorems <ul style="list-style-type: none"> ○ Commutative, associative • Distributive <ul style="list-style-type: none"> ○ Identity, redundancy ○ De Morgan's • Standard logical expressions <ul style="list-style-type: none"> ○ Sum of products and product of sums ○ Transform SOP into POS and vice versa • Simplify logic expressions using <ul style="list-style-type: none"> ○ Boolean theorems ○ Karnaugh map 	<ul style="list-style-type: none"> • for simplifying Boolean expressions • Represents logical expressions in standard forms (SOP and POS) according to the given truth table • Transforms SOP into POS and vice versa • Simplifies logic expressions using Boolean theorems, axioms, De Morgan's Laws and Karnaugh map 	
	4.3 Designs simple digital circuits using logic gates	<ul style="list-style-type: none"> • Truth tables and logic expressions for their designs (up to three inputs) • Digital circuit design 	<ul style="list-style-type: none"> • Identifies situations to apply logic circuits in day to day life • Designs logic expressions and truth table for identified applications • Designs digital circuits 	6
	4.4 Explores how combinational Logic	<ul style="list-style-type: none"> • Building blocks of CPU <ul style="list-style-type: none"> ○ Half adder 	<ul style="list-style-type: none"> • Identifies the major building blocks of 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
	circuits are used in CPU and sequential circuits in physical memory	<ul style="list-style-type: none"> ○ Full adder ● Storing bits in digital circuits <ul style="list-style-type: none"> ○ Feedback loop ○ Flip-flops 	CPU <ul style="list-style-type: none"> ● Creates truth table and logical expressions for half adder circuit ● Creates truth table and logical expressions for full adder circuit ● Briefly describes the usage of Flip-Flops 	
Competency 5 : Uses operating systems to manage the functionality of computers	5.1 Defines the term computer operating system (OS) and investigates its need in computer systems	<ul style="list-style-type: none"> ● Introduction to computer operating system ● Evolution of OS ● Main functions of an operating system <ul style="list-style-type: none"> ○ Providing interfaces ○ Process management ○ Resource management ○ Security and protection ● Classification of operating systems <ul style="list-style-type: none"> ○ Single user – single task ○ Single user – multi task ○ Multi user – multi task ○ Multi-threading ○ Real time ○ Time sharing systems 	<ul style="list-style-type: none"> ● Defines the computer operating system ● Briefly describes the evolution of OS ● Identifies the main functions and the abstractions (directories, files and data) provided by the operating system to the user ● Describes how the operating system manages the resources of a computer ● Classifies the 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			operating systems based on their users and tasks	
	5.2 Explores how an operating system manages directories/folders and files in computers	<ul style="list-style-type: none"> • File types <ul style="list-style-type: none"> ○ Need for file types (.exe, .jpg .txt, etc) • Directory and file organization <ul style="list-style-type: none"> ○ File hierarchy ○ File systems – FAT etc • File security <ul style="list-style-type: none"> ○ Passwords and access privileges • File storage management <ul style="list-style-type: none"> ○ Storage allocation <ul style="list-style-type: none"> ❖ Contiguous allocation ❖ Linked allocation ❖ Indexed allocation • Defragmentation • Maintenance of secondary storage <ul style="list-style-type: none"> ○ Need and outcome of disk formatting 	<ul style="list-style-type: none"> • Describes files and directories • Briefly describes the need of disk formatting • Identifies the need for file types • Lists attributes of file and directories • Describes the structure of the file systems • Illustrates the organization of files and directories • Briefly describes the methods used in file security • Briefly describes how an operating system manages file security • Briefly explains <ul style="list-style-type: none"> ○ Contiguous allocation ○ Linked allocation 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			<ul style="list-style-type: none"> ○ Indexed allocation ● Describes defragmentation and explains how it occurs 	
	5.3 Explores how an operating system manages processes in computers	<ul style="list-style-type: none"> ● Definition of process ● Interrupts and interrupts handling ● Process management ● Process states ● Process Transitions ● Process control block ● Context switching ● Process schedulers 	<ul style="list-style-type: none"> ● Explains processes ● Lists the operating system tasks when a process is created ● Lists the types of processes ● Lists the process states ● Explains process termination ● Distinguishes a process and a program ● Explains process states using the seven state process transition diagrams ● Describes process schedulers and scheduling policies ● Compares long, short and medium term schedulers ● Describes multi programming and its 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			<ul style="list-style-type: none"> needs • Describes time sharing systems • Compares multi programming vs. time sharing systems • Defines context switch • Briefly explains turnaround time, response time, throughput time and waiting time • Briefly explains the process control block and lists its contents 	
	<p>5.4 Explores how an operating system manages the resources</p>	<ul style="list-style-type: none"> • Memory management <ul style="list-style-type: none"> ○ Memory Management Unit(MMU) ○ Physical Memory ○ Virtual memory • Input and output device management <ul style="list-style-type: none"> ○ Device drivers ○ Spooling 	<ul style="list-style-type: none"> • Briefly explains the need of memory management and Memory Management Unit (MMU) • Briefly explains the virtual memory • Briefly explains paging and mapping • Briefly describes how an OS manages Input and 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			output devices <ul style="list-style-type: none"> • Briefly describes device drivers • Briefly describes the need of device drivers • Briefly describes spooling • Installs appropriate device drivers when connecting a peripheral 	
Competency 6: Explores the data communication and computer networking technologies to share information effectively	6.1 Explores signals and their properties	<ul style="list-style-type: none"> • Signal Types <ul style="list-style-type: none"> ○ Digital ○ Analog • Properties <ul style="list-style-type: none"> ○ Amplitude ○ Frequency ○ Wave length ○ Phase • Propagation speed in a media 	<ul style="list-style-type: none"> • Graphically represents digital and analog signals and their properties • Solves problems related to the relationship between signal properties 	4
	6.2 Explores signal transmission media	<ul style="list-style-type: none"> • Wires – Guided media (Twisted pair, coaxial cable, Fiber optics etc.) • Free space – Unguided media • Properties <ul style="list-style-type: none"> ○ Latency ○ Bandwidth ○ Noise ○ Attenuation 	<ul style="list-style-type: none"> • Classifies media as guided and unguided media • Describes how latency, bandwidth, noise, attenuation, and distortion affects signal 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ○ Distortion ● Simple topology: point-to-point connection 	transmission	
	6.3 Investigates how digital data is encoded using signal elements	<ul style="list-style-type: none"> ● Agreeing on signal elements to represent data (a protocol) <ul style="list-style-type: none"> ○ Two simple elements – two voltage levels (amplitudes) ○ Other possibilities (briefly) <ul style="list-style-type: none"> ❖ Frequency ❖ Phase ○ Changing speed of signal elements ○ Need for synchronization <ul style="list-style-type: none"> ❖ Timing/Clocks ❖ Manchester encoding ○ Handling errors <ul style="list-style-type: none"> ❖ Example: Parity 	<ul style="list-style-type: none"> ● Graphically represents encoding of digital data using two voltage levels as well as Manchester encoding ● Describes the possibility of using the changes in frequency and phase as signal elements ● Explains the need for synchronization and describes the problems that arise when the transmitter and the receiver are not synchronized ● Compares and contrasts the relationship between how fast the signal elements are changed and the bit rate in simple two voltage encoding 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			and Manchester encoding <ul style="list-style-type: none"> • Describes how the parity bit enables detecting a bit error 	
	6.4 Explores the use of Public Switched Telephone Network (PSTN) to connect two remote devices	<ul style="list-style-type: none"> • Public Switched Telephone Network <ul style="list-style-type: none"> ○ Providing a circuit between two points that can carry analog voice • Modulation, Demodulation and Modems <ul style="list-style-type: none"> ○ Encoding data using analog signal elements • Connecting two devices using Modems 	<ul style="list-style-type: none"> • Describes a PSTN as an analog voice carrying line • Describes how modems modulate analog signals so that they can be sent along a PSTN line • Draws a schematic diagram depicting two computers connected using modems via a PSTN line 	4
	6.5 Investigates how the problem of connecting multiple devices into a network is addressed	<ul style="list-style-type: none"> • All-to-all connections are impractical • A solution: Bus Topology <ul style="list-style-type: none"> ○ Simple ○ Problem: Controlling access to the bus (media) • Other topologies <ul style="list-style-type: none"> ○ Star ○ Ring ○ Mesh • Simplifying wiring <ul style="list-style-type: none"> ○ Hubs 	<ul style="list-style-type: none"> • Demonstrates the impracticality of connecting large number of devices in all-to-all topology • Demonstrates the simplicity of a Bus • Draws diagrams of different topologies • Describes the use of Hubs and Switches 	4

Competency	Competency Level	Contents	Learning outcomes	Periods	
		<ul style="list-style-type: none"> ○ Switches 	to simplify the wiring of a network and compares/contrasts their functionalities		
	6.6	Explores the role of Media Access Control (MAC) protocol	<ul style="list-style-type: none"> ● Local Area Network (LAN) ● Identifying devices <ul style="list-style-type: none"> ○ Addresses – MAC addresses ● Frames ● Orderly access to the media <ul style="list-style-type: none"> ○ Very simple protocol as an example – ALOHA ○ Improvements from ALOHA to Ethernet ● Broadcasting and Uni -casting messages 	<ul style="list-style-type: none"> ● Describes the need to uniquely name devices (addresses) so that the sender and the receiver can be identified ● Explains the role of frames as the unit of transmission ● Describes the need of a protocol to ensure orderly access to media with respect to a bus ● Briefly describes the evolution of MAC protocols from ALOHA to Ethernet 	4
	6.7	Explores how the multiple networks are interconnected to form the Internet	<ul style="list-style-type: none"> ● A device to connect two or more networks – gateway ● Need for globally unique uniform addressing independent of MAC addresses and LAN technology <ul style="list-style-type: none"> ○ IPv4 addresses ○ Assigning IPs to networks <ul style="list-style-type: none"> ❖ Sub-netting ❖ Subnet masks 	<ul style="list-style-type: none"> ● Explains the role of a gateway device in inter connecting two LANs ● Explain the need for a uniform, MAC protocol independent addressing scheme 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ❖ CIDR notation ❖ Private IP addresses ❖ DHCP <ul style="list-style-type: none"> ○ Scarcity of IPv4 addresses and IPv6 as a solution(an overview) • Finding the path to the destination <ul style="list-style-type: none"> ○ Routing and routers ○ Packet switching • Best effort delivery 	<p>and how IP addresses play that role</p> <ul style="list-style-type: none"> • Describes the role of subnet masks • Calculates subnet masks and IP address ranges for a given block of IP addresses and network sizes • Describes how DHCP is used to dynamically assign IP addresses • Describes the role of routers in finding a suitable path from the sender to the receiver • Explains packet switching and best effort delivery in IP networks 	
	6.8 Explores the role of transport protocols in the Internet	<ul style="list-style-type: none"> • Delivering data from an application process to another application process <ul style="list-style-type: none"> ○ Multiple applications at a host identified by an IP 	<ul style="list-style-type: none"> • Explains that it is not sufficient to deliver a message from one IP address to 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ❖ Multiplexing – multiple end points at the same IP ○ Ports and port numbers ○ UDP <ul style="list-style-type: none"> ❖ Properties ❖ Applications ○ TCP <ul style="list-style-type: none"> ❖ Properties ❖ Applications 	<p>another by demonstrating that the communication is from process to a process</p> <ul style="list-style-type: none"> • Explains the need for multiplexing messages and how port numbers identify the end points • Briefly describes the functionality of UDP and lists applications that use it • Briefly describes the functionality of TCP and lists applications that use it 	
	6.9 Explores some applications on the Internet	<ul style="list-style-type: none"> • Domain Name System (DNS) <ul style="list-style-type: none"> ○ IP addresses are hard to remember ○ Human friendly names ○ Hierarchical name space ○ Each domain is responsible for managing the names under it <ul style="list-style-type: none"> ○ Top level domains • HTTP • Client Server model 	<ul style="list-style-type: none"> • Describes the need for human friendly names instead of IP addresses • Explains the role of DNS in translating names to IP addresses • Graphically represent the 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			hierarchical and distributed structure of the DNS <ul style="list-style-type: none"> • Describes a simple GET request and its response in HTTP • Describes the client server model using DNS and HTTP 	
	6.10 Investigates the role of reference models to describe the network architecture	<ul style="list-style-type: none"> • TCP/IP model <ul style="list-style-type: none"> ○ Application ○ Transport ○ Internet ○ Host to network • OSI model <ul style="list-style-type: none"> ○ Application ○ Presentation ○ Session ○ Transport ○ Network ○ Data link ○ Physical 	<ul style="list-style-type: none"> • Describes the functions of layers of TCP/IP and OSI models • Describes the data units in different layers(packet, frame and bit) • Describes the data flow in a network using TCP/IP and OSI models 	4
	6.11 Investigates the security aspects of the communication and protection of devices connected to the Internet	<ul style="list-style-type: none"> • Encryption and digital signature – basic idea <ul style="list-style-type: none"> ○ Public Key ○ Private Key ○ Signing • Threats <ul style="list-style-type: none"> ○ Viruses 	<ul style="list-style-type: none"> • Identifies the need for confidentiality and authentication of messages and notes that the Internet does not provide 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ○ Trojans ○ Malware ○ Phishing ● Protection <ul style="list-style-type: none"> ○ Firewalls ○ Antivirus software ○ Education/ better awareness/ good practices 	<ul style="list-style-type: none"> ● Briefly explains the use of the public and private keys to encrypt and sign messages ● Describes different threats faced by networked systems and protection against them 	
	6.12 Explores the role of ISPs and technologies used for connecting Home Networks to the Internet	<ul style="list-style-type: none"> ● ISPs ● Connecting to ISP <ul style="list-style-type: none"> ○ Modems ○ DSL/ADSL ● A home LAN that uses private IPs <ul style="list-style-type: none"> ○ Network Address Translation /Proxies 	<ul style="list-style-type: none"> ● Describes the role of an ISP ● Explains the use of modems and dialup lines to connect a home machine to an ISPs network ● Explains the advantages of DSL/ADSL lines ● Explains the roles of NATs and Proxies in a LAN that uses private IPs 	4
Competency 7: Explores the systems concept and uses systems analysis and design	7.1 Explores Characteristics of Systems	<ul style="list-style-type: none"> ● Systemconcept ● Classification of systems <ul style="list-style-type: none"> ○ Open and closed systems ○ Natural and manmade systems ○ Living and physical systems 	<ul style="list-style-type: none"> ● Recalls the definition of systems ● Lists and describes the characteristics of systems ● Classifies and describes systems 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
methodology in developing information systems			with examples	
	7.2 Compares and contrasts different types of manmade systems in terms of their objectives and functionality	<ul style="list-style-type: none"> • Information systems <ul style="list-style-type: none"> ○ Office Automation Systems (OAS) ○ Transaction Processing Systems (TPS) ○ Management Information Systems (MIS) ○ Decisions Support Systems (DSS) ○ Executive Support Systems (ESS) ○ Geographical information systems (GIS) ○ Knowledge Management Systems (KMS) ○ Content Management Systems (CMS) ○ Enterprise Resource Planning Systems (ERPS) ○ Smart systems 	<ul style="list-style-type: none"> • Compares the objectives and functionality of different types of manmade systems • Distinguishes the different types of manmade systems in terms of objectives and functionality 	4
	7.3 Explores different information system development models and methods	<ul style="list-style-type: none"> • System development Lifecycle models <ul style="list-style-type: none"> ○ Waterfall ○ Spiral ○ Agile ○ Prototyping <ul style="list-style-type: none"> ❖ Rapid Application Development (RAD) • System development methodologies <ul style="list-style-type: none"> ○ Structured ○ Object Oriented 	<ul style="list-style-type: none"> • Lists and briefly describes system development models • Investigates the applicability of each model • Lists and describes the stages of System 	08

Competency	Competency Level	Contents	Learning outcomes	Periods
			Development Life Cycle (SDLC) in Waterfall model <ul style="list-style-type: none"> • Lists and describes phases of the SDLC in Spiral model • Lists and briefly describes system development methodologies 	
	7.4 Examines the Structured System Analysis and Design Methodology (SSADM)	<ul style="list-style-type: none"> • Introduction to SSADM • Stages of the system development life cycle 	<ul style="list-style-type: none"> • Defines SSADM • Lists and briefly describes the stages of SDLC covered by SSADM 	2
	7.5 Investigates the need for a new information system and its feasibility	<ul style="list-style-type: none"> • Preliminary investigation <ul style="list-style-type: none"> ○ Identification of the problems in the current system ○ Suggest alternative solutions ○ Prioritizing information systems needs • Feasibility study <ul style="list-style-type: none"> ○ Technical feasibility ○ Economic feasibility ○ Operational feasibility ○ Organizational feasibility 	<ul style="list-style-type: none"> • Describes the tasks in preliminary investigation stage • Identifies information problems in an organization • Identifies priorities of the problems to be solved • Describes the need of feasibility study • Lists and briefly describe the types of feasibility 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
	7.6 Uses different methods to analyze the current system	<ul style="list-style-type: none"> • Requirement analysis <ul style="list-style-type: none"> ○ Functional requirements ○ Non – functional requirements • Analytical Tools <ul style="list-style-type: none"> ○ Business Activity Modeling <ul style="list-style-type: none"> ❖ Business activity model ○ Data Flow Modeling (DFM) <ul style="list-style-type: none"> ❖ Data Flow Diagrams (DFD) ❖ Elementary processes and Elementary Process Descriptions (EPD) ❖ Document flow diagram ○ Logical Data Modeling (LDM) <ul style="list-style-type: none"> ❖ Logical Data Structure (LDS) • Business System Options (BSO) 	<ul style="list-style-type: none"> • Describes the need for requirement analysis • Describes type of requirements with examples for a given system • Defines requirements in IEEE standard • Lists the analytical tools and describes the purpose of them • Draws business activity model, context diagram, document flow diagram, data flow diagrams and logical data structure for a given system • Writes elementary process descriptions • Describes the need for business system options • Proposes business system options • Selects the most appropriate business system 	18

Competency	Competency Level	Contents	Learning outcomes	Periods
			option	
	7.7 Designs the proposed system	<ul style="list-style-type: none"> • Logical design tools <ul style="list-style-type: none"> ○ Logical Data flow modeling <ul style="list-style-type: none"> ❖ Logical Data flow diagrams for proposed system ❖ Elementary processes and elementary process description ❖ User Interface design ○ Logical Data modeling <ul style="list-style-type: none"> ❖ Logical data structure for the proposed system ○ Physical design of database <ul style="list-style-type: none"> ❖ Table and record specifications ❖ Data dictionary ❖ Database design 	<ul style="list-style-type: none"> • Describes the logical design • Describes the activities involve in the logical design stage • Reconstructs logical design of the proposed system starting from elementary processes to context diagram • Writes elementary process description in pseudo code • Specifies table and record specifications 	14
	7.8 Develops and tests the proposed system	<ul style="list-style-type: none"> • Program development • Database development • Testing <ul style="list-style-type: none"> ○ Test cases ○ White box testing ○ Black box testing ○ Unit testing ○ Integrated testing ○ System testing ○ Acceptance testing 	<ul style="list-style-type: none"> • Lists the testing methods for a newly designed system • Describes the testing methods for a newly designed system 	6
	7.9 Deploys the developed	<ul style="list-style-type: none"> • Deployment methods 	<ul style="list-style-type: none"> • Describes the 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
	system	<ul style="list-style-type: none"> ○ Parallel ○ Direct ○ Pilot ○ Phase ● Hardware/Software installation, data migration and user training ● Review, support and maintenance 	<p>methods of deployment of the developed system.</p> <ul style="list-style-type: none"> ● Describes the activities involved after implementation of a system 	
	7.10 Describes system implementation with off-the-shelf packaged systems	<ul style="list-style-type: none"> ● Advantages and disadvantages of using off-the-shelf packages ● Identification of package capabilities, work flows etc. ● Business process gap analysis ● Business process mapping ● Business process reengineering 	<ul style="list-style-type: none"> ● Describes the costs and benefits of off-the-shelf packages in terms of investment, operational and maintenance cost ● Describes the features and capabilities of packaged solutions related to standard business applications ● Identifies and describes differences between a given business process and features of off-the-shelf packages ● Maps business process activities 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			<p>onto work flow of the off-the-shelf packaged solution</p> <ul style="list-style-type: none"> • Identifies changes required in the current business process • Identifies customization requirements of off-the-shelf packaged solutions 	
Competency 8: Designs and develops database systems to manage data efficiently and effectively.	8.1 Learns the basics of information and data, and the need for databases	<ul style="list-style-type: none"> • Data vs. information • Structured Vs. unstructured data • Definition of database • Database models <ul style="list-style-type: none"> ○ Flat file system ○ Hierarchical model ○ Network model ○ Relational model ○ Object relational model • Comparison of database models 	<ul style="list-style-type: none"> • Distinguishes data and information • Defines database • Lists and briefly describes the database models • Compares and contrasts database models in terms of their features 	2
	8.2 Describes the main components of the relational database model	<ul style="list-style-type: none"> • Relations / Tables <ul style="list-style-type: none"> ○ Attributes / Columns ○ Tuples / Rows ○ Relationships • Types of Constraints <ul style="list-style-type: none"> ○ A NOT NULL Constraint ○ A Unique Constraint 	<ul style="list-style-type: none"> • Defines relations / tables • Names and describes main components of a relational database • Describes the 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ○ A Primary Key Constraint ○ A Foreign Key Constraint ○ A (Table) Check Constraint 	<ul style="list-style-type: none"> relationships in terms of relational database model • Briefly explains the types of constrains 	
	<p>8.3 Analyzes the main components of a database system</p>	<ul style="list-style-type: none"> • Data Base Management System • Data definition language (DDL) <ul style="list-style-type: none"> ○ Introduction to SQL ○ Classification of SQL ○ Creating, using relational database using DDL <ul style="list-style-type: none"> ❖ Creating table ❖ Alter table <ul style="list-style-type: none"> - Inserting and deleting attributes - Adding and deleting foreign key and primary key ❖ Drop tables ❖ Drop databases • Data manipulation Language (DML) <ul style="list-style-type: none"> ○ DML Features in SQL <ul style="list-style-type: none"> ❖ Inserting, modifying, retrieving, updating deleting data ○ Select Query <ul style="list-style-type: none"> ❖ Extracting rows and columns from single table ❖ Extracting rows and columns from multiple tables using inner join operation ❖ Insert Query 	<ul style="list-style-type: none"> • Lists and briefly describes the component of a database system • Describes the database management system • Defines SQL • Distinguishes between DDL vs. DML • Uses appropriate SQL commands for creating and using database • Uses appropriate commands to create tables with suitable fields and data types • Sets primary key and foreign key while creating table • Uses primary key and foreign key after completion of a 	14

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ❖ Update Query ❖ Delete Query 	<p>table</p> <ul style="list-style-type: none"> • Creates relationships among tables • Uses appropriate SQL commands to Insert and delete columns, delete foreign key / primary key and to drop table • Uses appropriate SQL commands to drop database • Uses appropriate commands to Insert, modify retrieve, update and delete data. • Uses appropriate DML commands to query data according to the requirements 	
	8.4 Designs the conceptual schema of a database	<ul style="list-style-type: none"> • ER (Entity Relationship) diagrams <ul style="list-style-type: none"> ○ Entities, attributes ○ Entity identifiers ○ Relationships ○ Cardinality • Introduction to EER (Extended ER) 	<ul style="list-style-type: none"> • Describes ER diagram • Describes the components of an ER diagram (entities, attributes) 	12

Competency	Competency Level	Contents	Learning outcomes	Periods
		diagrams	<ul style="list-style-type: none"> • Describes entity identifiers • Lists and describes relationships • Describes cardinality • Identifies the requirements of a given scenario • Selects entities, attributes and according to the requirement • Draws the ER diagram • Explains the EER diagrams 	
	8.5 Designs the logical schema of a database	<ul style="list-style-type: none"> • Definition of the logical schema • Database schema design <ul style="list-style-type: none"> ○ Relational schema ○ Relation instances ○ Candidate key ○ Primary key ○ Alternate key ○ Foreign key • Domain 	<ul style="list-style-type: none"> • Defines logical schema of a database • Describes relational schema • Describes relational instances • Briefly describes Candidate key, primary key, alternate key and foreign key 	6
	8.6 Transforms ER diagrams	<ul style="list-style-type: none"> • Entity transformation 	<ul style="list-style-type: none"> • Describes the 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
	to logical schema	<ul style="list-style-type: none"> • Attribute transformation • Relationship transformation 	<p>methods of transformation ER diagram to logical schema</p> <ul style="list-style-type: none"> • Transforms ER diagrams (entity, attribute, relationships) to logical schema 	
	8.7 Normalizes database schema to improve performance	<ul style="list-style-type: none"> • Need for normalization- <ul style="list-style-type: none"> ○ Redundancies and anomalies <ul style="list-style-type: none"> ❖ Insert ❖ Update ❖ Delete • Functional dependencies <ul style="list-style-type: none"> ○ Full dependency ○ Partial dependency ○ Transitive dependency • Levels of normalization <ul style="list-style-type: none"> ○ Zero normal form ○ First normal form ○ Second normal form ○ Third normal form 	<ul style="list-style-type: none"> • Describes the functional dependencies and categorizes them • Describes abnormalities of an improperly designed table when modifying in terms of insert, update and delete • Describes the zero normal form • Explains the abnormalities which are reduced after the first normal form • Lists the conditions for executing the second normal form • Explains the abnormalities which 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			<p>are reduced after the second normal form</p> <ul style="list-style-type: none"> Explains the abnormalities which are reduced after the third normal form 	
Competency 9 : Develops algorithms to solve problems and uses python programming language to encode algorithms	9.1 Uses problem-solving process	<ul style="list-style-type: none"> Understanding the problem Defining the problem and boundaries Planning solution Implementation 	<ul style="list-style-type: none"> Describes the steps of problem solving process Implements the solution 	2
	9.2 Explores the top down and stepwise refinement methodologies in solving problems	<ul style="list-style-type: none"> Modularization Top down design and stepwise refinement Structure charts 	<ul style="list-style-type: none"> Uses stepwise refinement methodology to solve problems Draws structures charts to illustrate a solution for a system 	4
	9.3 Uses algorithmic approach to solve problems	<ul style="list-style-type: none"> Algorithms <ul style="list-style-type: none"> Flow charts Pseudo codes Hand traces 	<ul style="list-style-type: none"> Briefly describes algorithms Identifies the standard symbols used to draw flow 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			charts <ul style="list-style-type: none"> • Draws flow charts to illustrate solutions to a given problem • Writes pseudo codes to illustrate solutions to a given problem • Uses hand traces to verify the solutions 	
	9.4 Compares and Contrasts different programming paradigms	<ul style="list-style-type: none"> • Evolution of programming languages • Programming paradigms <ul style="list-style-type: none"> ○ Imperative languages ○ Declarative languages ○ Object oriented languages 	<ul style="list-style-type: none"> • Describes the evolution of programming language in terms of generations • Compares and contrasts imperative, declarative, object oriented languages 	2
	9.5 Explores the need of program translation and the type of program translators	<ul style="list-style-type: none"> • Need of program translation • Source program • Object program • Program translators <ul style="list-style-type: none"> ○ Interpreters ○ Compilers ○ Hybrid approach • Linkers 	<ul style="list-style-type: none"> • Describes the need of translation of a program • Compares the source and object program • Lists and briefly describes the types of program translators • Briefly describes the 	2

Competency	Competency Level	Contents	Learning outcomes	Periods
			function of linkers	
	9.6 Explores integrated development environment (IDE) to identify their basic features	<ul style="list-style-type: none"> • Basic features of IDE • Instructions to use <ul style="list-style-type: none"> ○ Opening and saving files ○ Compiling, executing programs • Debugging facilities 	<ul style="list-style-type: none"> • Identifies the basic features of IDE • Practices the instructions to <ul style="list-style-type: none"> ○ Open and save files ○ Compile, execute programs • Uses the debugging facilities in IDE 	4
	9.7 Uses an imperative programming language to encode algorithms	<ul style="list-style-type: none"> • Structure of a program • Comments • Constants and Variables • Primitive data types • Operator categories <ul style="list-style-type: none"> ○ Arithmetical, relational, logical, bitwise • Operator precedence • Input / output <ul style="list-style-type: none"> ○ Input from keyboard ○ Output to standard devices 	<ul style="list-style-type: none"> • Identifies the structure of a program • Uses comments to identify the usage of code for future reference • Uses constants and variables in a program appropriately • Identifies the primitive data types of a given program language • Identifies and uses operators in a program • Identifies precedence of 	10

Competency	Competency Level	Contents	Learning outcomes	Periods
			operators <ul style="list-style-type: none"> • Writes programs with the facilities of input from keyboard and output to standard devices 	
	9.8 Uses control structures in developing programs	<ul style="list-style-type: none"> • Control Structures <ul style="list-style-type: none"> ○ Sequence ○ Selection ○ Repetition <ul style="list-style-type: none"> ❖ Iteration ❖ Looping 	<ul style="list-style-type: none"> • Briefly describes control structures • Lists and briefly describes the types of control structures • Uses control structures appropriately in programming • Applies nested control structures in programs 	12
	9.9 Uses sub-programs in programming	<ul style="list-style-type: none"> • Types of subprograms <ul style="list-style-type: none"> ○ Built in ○ User defined <ul style="list-style-type: none"> ❖ Structure ❖ Parameter passing ❖ Return values ❖ Default values ❖ Scope of variables 	<ul style="list-style-type: none"> • Briefly describes the functions • Lists and briefly describes the types of functions • Identifies the structure of a function • Compares local and global variables • Identifies the behavior of a variable in terms of 	10

Competency	Competency Level	Contents	Learning outcomes	Periods
			life time <ul style="list-style-type: none"> Identifies the need of return values and writes functions to obtain the appropriate return value Writes functions using relevant parameters and arguments Uses user defined functions 	
	9.10 Uses data structures in programs	<ul style="list-style-type: none"> Data structures <ul style="list-style-type: none"> Strings Lists Tuples Dictionaries 	<ul style="list-style-type: none"> Briefly explains the use of data structures Uses relevant data structures in programming 	8
	9.11 Handles files and databases in programs	<ul style="list-style-type: none"> File handling <ul style="list-style-type: none"> Basic file operations 	<ul style="list-style-type: none"> Uses basic file operations (open, close, read write and append) 	6
	9.12 Manages data in databases	<ul style="list-style-type: none"> Connecting to a database Retrieve data Add, modify and delete data 	<ul style="list-style-type: none"> Embeds SQL statements in programming languages to retrieve, add, modify and delete data 	4
	9.13 Searches and sorts data	<ul style="list-style-type: none"> Searching techniques 	<ul style="list-style-type: none"> Uses sequential 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ○ Sequential search ● Sorting techniques <ul style="list-style-type: none"> ○ Bubble sort 	<ul style="list-style-type: none"> searching technique appropriately ● Implements bubble sort technique appropriately 	
Competency 10: Develops websites incorporating multi-media technologies (using HTML 5)	10.1 Explores the need for web	<ul style="list-style-type: none"> ● The world wide web (www) ● Types of web sites <ul style="list-style-type: none"> ○ Information, news ○ Personal, educational, commercial, Research ○ Web portals 	<ul style="list-style-type: none"> ● Describes www ● Analyses the systematic arrangements of contents and structure of a web 	8
	10.2 Analyses user requirements(multimedia contents)	<ul style="list-style-type: none"> ● Defining the objectives of a website ● Contents to be displayed 	<ul style="list-style-type: none"> ● Creates effective and appropriate information layout of a website ● Identifies the web pages of a website ● Identifies the contents of a web page ● Identifies navigationstructure 	4
	10.3 Identifies appropriate HTML tags to design a single web page	<ul style="list-style-type: none"> ● Building blocks of a web page <ul style="list-style-type: none"> ○ Page definition <ul style="list-style-type: none"> ❖ <html></html> ○ Head section <ul style="list-style-type: none"> ❖ <head></head> ❖ <title></title> ○ Body section 	<ul style="list-style-type: none"> ● Analyses the arrangement of contents of a web page ● Analyses the organization of contents in a web 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ❖ <body></body> • Background color <ul style="list-style-type: none"> ○ Text formatting ❖ <h1>...<h6>tags ❖ <p></p> ❖
 ❖ Underline, bold, italic ❖ <ul style="list-style-type: none"> - Size and color • Adding comments 	<ul style="list-style-type: none"> page • Creates a simple web page 	
	10.4 Uses HTML to create linked web pages	<ul style="list-style-type: none"> • Contents of a website <ul style="list-style-type: none"> ○ Home page ○ Linked pages ○ Hyperlink <ul style="list-style-type: none"> ❖ Different sections of the same page(book mark) ❖ Different pages of a same site(local link) ❖ Pages of different sites (External link) • Lists <ul style="list-style-type: none"> ○ Ordered lists ○ Unordered lists ○ Definition lists • Image • Tables <ul style="list-style-type: none"> ○ <table></table> ○ <th></th> ○ <tr></tr> ○ <td></td> 	<ul style="list-style-type: none"> • Explains hypertext markup language • Identifies the standards of HTML • Saves the source document with suitable extensions • Designs the web page by inserting appropriate multimedia objects according to user requirements • Organizes data using lists and tables in the web page • Links pages and multimedia objects to the web page 	16

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ○ <caption> ○ Merging columns and rows ● Multimedia objects <ul style="list-style-type: none"> ○ Audio ○ Video 		
	10.5 Uses Style sheet to change the appearance of web pages	<ul style="list-style-type: none"> ● Introduction to style sheet ● CSS <ul style="list-style-type: none"> ○ Syntax, comments ● CSS selectors <ul style="list-style-type: none"> ○ element, id, class, group ● Ways of inserting CSS <ul style="list-style-type: none"> ○ Internal, external, inline ● Appearance formatting <ul style="list-style-type: none"> ○ Background (color, image) ○ Text and fonts ○ Links ○ Lists ○ Tables 	<ul style="list-style-type: none"> ● Briefly explains style sheet and its usage ● Uses the comments and correct syntax in CSS ● Uses appropriate selectors to select elements in CSS ● Inserts CSS in HTML web pages to improve the appearance ● Applies various CSS formatting in HTML web pages to improve the appearance 	8
	10.6 Uses an authoring tool to create web pages	<ul style="list-style-type: none"> ● Introduction to web authoring tools 	<ul style="list-style-type: none"> ● Briefly explains web authoring tools ● Creates web pages using a web authoring tool 	10
	10.7 Creates dynamic web pages using PHP and	<ul style="list-style-type: none"> ● Introduction to dynamic web pages ● Embedding PHP code into web page 	<ul style="list-style-type: none"> ● Defines dynamic web pages 	6

Competency	Competency Level	Contents	Learning outcomes	Periods
	MySQL	<ul style="list-style-type: none"> ○ Variables ○ Arrays ○ Control structures ○ Functions ○ Database connectivity ○ Working with databases ● Forms <ul style="list-style-type: none"> ○ Input element <ul style="list-style-type: none"> ❖ Type attribute ❖ Name attribute ❖ Value attribute ○ Text input (Password) ○ Radio buttons ○ Check box ○ Selection ○ Submit buttons ○ Reset button ○ Action attribute ○ Method attribute <ul style="list-style-type: none"> ❖ Get ❖ Post ○ Grouping form data using <fieldset> tag ○ Saving form data into database ● Creating data source and entering data ● Creating PHP code to retrieve data from MySQL database ● Set form values using retrieved data 	<ul style="list-style-type: none"> ● Creates data source and enters data ● Creates PHP code to save/retrieve data to and from MySQL ● Develop simple web based information systems 	

Competency	Competency Level	Contents	Learning outcomes	Periods
	10.8 Publishes and maintains web sites	<ul style="list-style-type: none"> • Local publishing <ul style="list-style-type: none"> ○ Own computer, intranet • Internet publishing <ul style="list-style-type: none"> ○ Connecting to the web Service provider ○ Publishing web Pages on web server • Factors affecting performance of website 	<ul style="list-style-type: none"> • Publishes the developed website locally • Identifies free web hosting sites from the Internet • Publishes the developed website through a free web hosting site • Investigates the factors affecting performance of website 	4
Competency 11: Explores IoT and identify the building blocks of digital systems to develop simple applications	11.1 Acquires the knowledge of basic building blocks of digital systems	<ul style="list-style-type: none"> • Microprocessor Development Systems (MDS) (Arduino Board, Raspberry Pi board, board with etc.) <ul style="list-style-type: none"> ○ Introduction <ul style="list-style-type: none"> ❖ Microprocessor Development Systems vs. traditional computer systems ○ Features <ul style="list-style-type: none"> ❖ Analog Input ❖ Digital Input ❖ Microprocessor ❖ Digital Output ❖ RX and TX Pins ❖ USB Port ❖ Power supply ❖ Reset Switch ○ Connect to the computer 	<ul style="list-style-type: none"> • Identifies and lists Microprocessor Development Systems • Describes available features on Microprocessor Development Systems • Identifies necessary software and download them from the Internet to design and write programs into Microprocessor Development System • Develops simple applications using to Microprocessor 	8

Competency	Competency Level	Contents	Learning outcomes	Periods
		<ul style="list-style-type: none"> ❖ USB Connectivity ❖ IDE Software (code editor, compiler and programmer) ○ Simple applications <ul style="list-style-type: none"> ❖ Switch on/off a LED ❖ Sending ambient light intensity with a LDR and switching on LEDs on light intensity ❖ Sensing the room temperature with temperature sensor and switching on a fan on high temperature and off ❖ Door open/close detection with magnet switch 	<p>Development Systems</p> <ul style="list-style-type: none"> - Switch on/off LEDs on ambient light intensity - Door open/close detection with magnetic switch - Run a fan on high temperature 	
	<p>11.2 Explores the Internet of Things (IoT) to create a simple application</p>	<ul style="list-style-type: none"> ● Introduction to IoT <ul style="list-style-type: none"> ○ Definition ○ Needs ○ IoT applications ○ Enabling technologies ● Simple IoT application to construct a remote switch 	<ul style="list-style-type: none"> ● Defines IoT (Internet of Things) ● Identifies the needs of IoT to make day to day smart ● Discusses the various applications of IoT ● Identifies the enabling technologies for IoT ● Designs and Implements an IOT application to remotely control a device through Internet Example :- ON/OFF a television 	<p>7</p>

Competency	Competency Level	Contents	Learning outcomes	Periods
<p>Competency 12: Explores applicability of ICT to business organizations and the competitive marketplace</p>	<p>12.1 Explores the role of ICT in the world of business</p>	<ul style="list-style-type: none"> • Digital economy <ul style="list-style-type: none"> ○ New business methods in digital economy <ul style="list-style-type: none"> ❖ Reverse auctions ❖ Group purchasing ❖ e-Marketplace • Pure brick, brick and click, and pure click organizations • Business functions and the role of ICT <ul style="list-style-type: none"> ○ Accounting and ICT ○ Human resource and ICT ○ Production and ICT ○ Marketing & sales and ICT ○ Supply chain management and ICT ○ Business communication and ICT ○ Secure payment mechanisms <ul style="list-style-type: none"> ❖ Payment gateways ❖ Secure credit card payments ❖ Third party systems <ul style="list-style-type: none"> - PayPal etc ❖ Mechanisms <ul style="list-style-type: none"> - Data encryption - Micro credit payments (bit coin etc.) • Threats and opportunities in ecommerce <ul style="list-style-type: none"> ○ Privacy ○ Product commercialization 	<ul style="list-style-type: none"> • Defines digital economy • Lists and describes new business methods in digital economy • Identifies the concepts behind pure brick, brick and click, and pure click organizations • Describes the role of ICT in business functions of an organization 	4
	<p>11.2 Analyses the relationship between ICT and</p>	<ul style="list-style-type: none"> • E-Commerce and e-business <ul style="list-style-type: none"> ○ The scope of e-commerce and e- 	<ul style="list-style-type: none"> • Distinguishes the e-commerce and e- 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
	business operations	business <ul style="list-style-type: none"> ○ Types of e-business transactions <ul style="list-style-type: none"> ❖ B2B, B2C, C2C, C2B, B2E, G2C ● E-Business <ul style="list-style-type: none"> ○ Virtual storefronts ○ Information brokers ○ Online marketplace ○ Content provider ○ Online service provider ○ Portal ○ Virtual Community ● Advantages and disadvantages of e-business 	business <ul style="list-style-type: none"> ● Investigates the scope of e-commerce and e-business ● Lists and briefly describes the types of e-business transactions ● Identifies the advantages and disadvantages of e-business 	
	12.3 Analyses the ICT in terms of generating and delivering an improved products and services to consumers	<ul style="list-style-type: none"> ● E-marketing <ul style="list-style-type: none"> ○ Concepts of marketing ○ Use of ICT in marketing <ul style="list-style-type: none"> ❖ Web advertising etc ● Databases in marketing <ul style="list-style-type: none"> ○ Predicting customer behavior with AI tools and techniques ○ Gaining competitive advantages through ICT ● Mobile Marketing 	<ul style="list-style-type: none"> ● Defines e-marketing ● Identifies the role of ICT in e-marketing ● Investigates the usage of database in marketing activities to improve the product and services according to the requirements of the customers ● Identifies the ways of gaining competitive advantages using 	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			ICT	
Competency 13: Explores new trends and future directions of ICT	13.1 Explores new trends and future directions in computing	<ul style="list-style-type: none"> • Intelligent and emotional computing • Artificial intelligence • Man-machine coexistence • Machine to machine coexistence 	<ul style="list-style-type: none"> • Describes intelligent and emotional computing. • Explains artificial intelligences • Appreciates man-machine coexistences 	4
	13.2 Explores the fundamentals and applications of agent technology	<ul style="list-style-type: none"> • Software agents • Multi-agent systems • Applications of Agent systems 	<ul style="list-style-type: none"> • Briefly describes software agents and their characteristics • Briefly describes multi-agent systems and their characteristics • Identifies the applications of agent systems 	4
	13.3 Analyzes the existing models of computing and proposes new models	<ul style="list-style-type: none"> • Beyond von-Neumann computer • Nature inspired computing • Biology inspired computing • Fundamentals of quantum computing • Applications 	<ul style="list-style-type: none"> • Predicts the technologies beyond von-Neumann computers 	4
Competency 14: Designs and	14.1 Conducts a project on designing an information system			One period per week

Competency	Competency Level	Contents	Learning outcomes	Periods
Implements a simple Information system as the project				for a duration of one year
	14.2 Implements and demonstrates the Information system			

8.0 Learning Teaching process

Information and Communication Technology is not only a dynamic subject; it is also a living subject. It is necessary to update one's knowledge in order to be alert to the latest findings in this area. ICT has taken such an important position that the percentage of literacy in ICT has come to be regarded as an index of development. It is essential that the proposed method of teaching should be student-centered as this subject is essentially practice-oriented. In view of the fact that this is an essentially practical subject, it is vital that a student is involved in self study apart from the day to day learning- teaching process in order to ensure that subject matter learned is firmly grasped. There is need for special attention to be paid to the encouragement of the student for self-study. Further, just as much as knowledge, attitudes and skills, as well as social values, legal constraints related to the subject carry with them the imperatives of a sense and spirit of self-discipline. It is essential that the learning-teaching evaluation process is so organized as to highlight the importance of computer use.

The global trend in present day education is to introduce competency-based curricula, which promote collaborative learning through student centered activities where learning predominates teaching. It is intended for the students to actively participate in activities, which enhance the development of individual social and mental skills. The following aspects are emphasized.

- 1. Teachers have the freedom to follow most suitable teaching method to achieve the desired competencies.**
- 2. Allow the students to acquire hands on experience through self-directed activities.**

3. Direct students to acquire knowledge and information through reliable sources wherever necessary.

9.0 School Policies and Programs

It needs to be noted at the onset, that the success of the classroom learning-teaching process has an immense bearing on the effective actualization of the expected aims of the subject Information and Communication Technology. Therefore, it is important that the school policy and programs are organized in keeping with these expectations. It is important, in the achievement of the aims of this subject that the novelty of the subject and the consequent paucity of knowledge regarding this subject in student, should be taken into consideration.

The number of periods available for this subject is 300 per year. However, the number of periods in this revised syllabus is 442 for both academic years and this includes practical sessions for the appropriate competency levels. Apart from the above, 30 periods are set apart, spread throughout the year, for the Project in Grade 13.

Practical sessions are so important, as student should know how to apply what they have learnt and experienced throughout this learning activities. In order to acquire a main competency as included in the syllabus, students are required to practice some graded exercises followed by one or more real world applications.

Students have to maintain an activity logbook to record their activities done during this practical session and should be presented to the teacher in charge to maintain its correctness and consistency.

The individual project to be assigned in Grade 13 should be implemented outside normal classroom sessions. Thirty periods, however, will be devoted for teacher led discussions plus practical at different stages of the project. For the success of this activity, which comprises only individual practical works, arrangement will have to be made for the students to use the computer laboratory even outside the timetabled sessions.

10.0 Assessment and Evaluation

It is intended to implement this syllabus in schools with the School Based Assessment (SBA) process. Teachers will prepare creative teaching-learning instruments on the basis of school terms.

The details together with the format and the nature of questions will be introduced by the Department of Examinations.