Information and Communication Technology

Teachers' Guide
Grade 13

(Effective from 2018)

Department of Information Technology
National Institute of Education
Maharagama
Sri Lanka

www.nie.lk

Information and Communication Technology
Grade 13 –Teacher's Guide

CONTENTS   **Page No**

Message from the Director General

With the primary objective of realizing the National Educational Goals recommended by the National Education Commission, the then prevalent content based curriculum was modernized, and the first phase of the new competency based curriculum was introduced to the eight year curriculum cycle of the primary and secondary education in Sri Lanka in the year 2007

The second phase of the curriculum cycle thus initiated was introduced to the education system in the year 2015 as a result of a curriculum rationalization process based on research findings and various proposals made by stake holders.

Within this rationalization process, the concepts of vertical and horizontal integration have been employed in order to build up competencies of students, from foundation level to higher levels, and to avoid repetition of subject content in various subjects respectively and furthermore, to develop a curriculum that is implementable and student friendly.

The new Teachers' Guide has been introduced with the aim of providing the teachers with necessary guidance for planning lessons, engaging students effectively in the learning teaching process, and to make Teachers' Guide help teachers to be more effective within the classroom. Further, the present Teachers' Guide gives the necessary freedom for the teachers to select quality inputs and activities in order to improve student competencies. Since the Teachers' Guide does not place greater emphasis on the subject content prescribed for the relevant grades, it is very much necessary to use the Guide along with the text books compiled by the Educational Publications Department, if the Guides are to be made more effective.

The primary objective of this rationalized new curriculum, the new Teachers' Guide, and the new prescribed texts are to transform the student population into a human resource replete with the skills and competencies required for the world of work, through embarking upon a pattern of education which is more student centered and activity based.

I wish to make use of this opportunity to thank and express my appreciation to the members of the Council and the Academic Affairs Board of the NIE and the resource persons who contributed to the compiling of these Teachers' Guide and other parties for their dedication in this endeavor.

Dr. (Mrs.) Jayanthi Gunasekara

Director General

National Institute of Education

Curriculum Committee

Guidance and Approval
Academic Affairs Board National Institute of Education

Subject Coordinator
Mr.S.Shanmugalingam
Department of Information Technology
Senior Lecturer
National Institute of Education

Resource Contributions

Mr. D.Anura.Jayalal
Director
,Department of IT,
National Institute of Education

Mr.S.Shanmugalingam
Senior Lecturer
Department of Information Technology
National Institute of Education

Dr. Damith D Karunarathna
Senior Lecturer
UCSC
University of Colombo.

Dr. Gamini Wijerathna
Dean
Faculty of Computing Technology
University of Kelaniya

Dr..H.K.T.K.Wijayasiriwardhane
Senior Lecturer
Depatment of Industrial Management
Faculty of Science
University of Kelaniya.

Dr. ..K.Thabotharan
Senior Lecturer
Faculty of Science
University of Jaffna

Dr. P.M.T.P.Sandirigama
Senior Lecturer
Faculty of Engineering
University of Peradeniya

Ms..H.P.Rukmalee Premarathne
Assistant Director of Education
Ministry of Education.

Ms. A.P.N.De Silva   Teacher
                                            Almeda Maha Vidyalaya ,
                                            Akuressa

Mr. K.A.Udara Ariyarathne   Teacher
                                            Dehiovita National School.,
                                            Dehiovita.

Mr. S.Sarveswaran   Teacher
                                            Vavuniya Saivapragasa Ladies College
                                            Vavuniya

.

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 was as a main subject for GCE (A/L) 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.

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).

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 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.

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

Term-wise Unit Breakdown

Term	Units	No. of Period	
1st Term	8.1, 8.2, 8.3,8.4, 8.5, 8.6, 8.7 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7	50 28	78
2nd Term	9.8, 9.9, 9.10, 9.11,9.12, 9.13 10.1, 10.2, 10.3, 10.4	46 32	78
3rd Term	10.5, 10.6, 10.7, 10.8 11.1,11,2 12.1, 12.2,12.3 13.1, 13.2, 12.3	28 15 12 12	67

Proposed Number of Periods for Units

No	Units	No. of periods
1	Concept of ICT	28
	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
12	ICT in Business	12
13	New trends and Future Directions of ICT	12
14	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	• Life cycle of data
		  ○ 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
		  - Introduction
			• 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

Competency	Competency Level	Contents	Learning outcomes	Periods

	1.2 Investigates the need of technology to create, disseminate and manage data and information	• Applicability of information in day to day life
		  o Decision making
		  o Policy making
		  o Predictions
		  o Planning, scheduling and monitoring
		• Drawbacks of manual methods in manipulating data and information
		  o Inconsistency and duplication in data, room for errors, human errors and delay in processing
		  o Lack of sharing information and reduced customer services
		• Infeasibility of applying manual methods where they can be harmful to humans
		• Emergence of ICT era
		  o 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
			• Identifies the drawbacks of manual data processing methods
			• 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
				6

Competency	Competency Level	Contents	Learning outcomes	Periods
			various domains • Investigates the safety issues of human operators in various applications	

	1.3 Formulates an abstract model of information creation and evaluates its compliance with ICT	• Abstract model of information creation
		    ○ Input, process, output
		    ○ Its appropriateness to Computer and ICT
			• 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	• Hardware
		    ○ Classification of hardware components
		• Software
		    ○ Classification of software
			• Defines and classifies hardware and software components
			• Distinguishes
				2

Competency	Competency Level	Contents	Learning outcomes	Periods
		• Human Operators o Need of human operators in information systems	proprietary software and open source software • 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	• Steps in data processing:
		  o Data gathering
		  o Data validation
		  o Data processing
		  o Data output
		  o Data storage
		• Data gathering methods
		  o Manual methods
		  o Semi-automated and automated methods
		• Tools - (OMR, OCR, MICR, card/tape readers, magnetic strip readers, bar code readers, sensors and loggers)
		• Data validation methods
		  o Data type check
		  o Presence check
		  o Range check
		• Modes of data input
			• 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
		○ Direct and remote ○ Online and offline • Data processing ○ Batch and real time • Output methods ○ 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	• Application of ICT in: ○ Education ○ Healthcare ○ Agriculture ○ Business and finance ○ Engineering ○ Tourism ○ Media and journalism ○ Law enforcement	• 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	• Benefits caused by ICT ○ Social benefits ○ Economic benefits • Issues caused by ICT ○ Social ○ Economical ○ Environmental ○ Ethical ○ Legal ○ Privacy ○ Digital divide • Confidentiality	• 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	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		• Stealing / Phishing • Piracy • Copyright / intellectual property laws • Plagiarism • Licensed / unlicensed software	• Investigates the legal situation connected with the usage of ICT • 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	

Competency 2: Explores the evolution of computing devices, so as to be able to	2.1 Elicits the significant changes occurred in the computers from generation to generation with more emphasis on the evolution of	• History of computing
		  o Early calculating aids
		    ❖ mechanical
		    ❖ electromechanical
		  o Electronic age of computing
			• Categorizes the early calculating aids with examples
			• Describes the generations of
				4

Competency	Competency Level	Contents	Learning outcomes	Periods

describe and compare the performance of modern computers	processors	• Generation of computers
		  o 1G, 2G, 3G, 4G and future
		• Different types of classifications
		  o Technology
		    ❖ analog, digital
		  o Purpose
		    ❖ special /general
		  o Size
		    ❖ super, mainframe, mini, micro (mobile devices –smart phones, tablet devices and phablets)
			computers with their features in a table
			• 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	• Major hardware components o 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	• 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	6

Competency	Competency Level	Contents	Learning outcomes	Periods
		• Storage devices(fixed internal hard 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) • Parallel and grid computing	for parallel and grid computing	

	2.3 Explores the Von-Neumann Architecture	• Von-Neumann Architecture
		  o Stored program control concept
		  o Components (input, output, memory, Processor control unit and processing ALU unit)
		 • Fetch-execute cycle
		 • Central processing unit (CPU)
		  o Arithmetic and logic unit (ALU)
		  o Control unit (CU)
		  o Memory (Registers)
		  o Data and control bus
		  o Multi-core processors
			• 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	• Memory hierarchy
			  o Need of memory hierarchy
			  o Comparison criteria
			    ❖ Physical size / density of data
			    ❖ Access method
			    ❖ Access time (elapsed time/delay)
			    ❖ Capacity
			    ❖ Cost
			• Volatile memory and their characteristics
			  o Registers
			  o Types of cache memory
			  o Main memory – RAM
			  o Types of RAM
			    ❖ SRAM, DRAM, SDRAM
			• Non-volatile memory and their characteristics
			  o Types of ROMs
			    ❖ PROM, EPROM and EEPROM
			  o Secondary storage
			    ❖ magnetic, optical and flash memory
				• 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
					6

Competency	Competency Level	Contents	Learning outcomes	Periods
			• Compares and contrasts each type of memory in terms 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	• Need for instruction and data representation in digital devices
		• Methods of instruction and data representation in computers
		  ○ Representation of data in two states (0,1)
		• Number systems used in computing
		  ○ Binary, octal, hexadecimal
		  ○ Conversion between number systems
		• Representation of decimal numbers (signed and unsigned)
		  ○ Signed integer representations
		    ❖ Signed magnitude
		    ❖ One's complement
		    ❖ Two's Complement
			• 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
				10

Competency	Competency Level	Contents	Learning outcomes	Periods
			numbers to binary and hexadecimal, and vice versa • 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	• Methods of character representation ○ BCD ○ EBCDIC ○ ASCII ○ Unicode	• 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

Competency	Competency Level		Contents	Learning outcomes	Periods

	3.3	Uses basic arithmetic and logic operations on binary numbers	• Binary arithmetic operations - (integers only)
			  ○ Addition, subtraction
			• Logical operations
			  ○ Bitwise logical operations
				• Works out additions (multiple numbers with or without carryovers) – in binary numbers
				• Works out subtraction (with or without borrowing) – in binary numbers
				• Works out NOT, AND, OR, XOR bitwise operations
					4

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	• Digital logic gates and truth tables
			  ○ Basic logic gates
			    ❖ NOT, AND, OR, and XOR
			  ○ Combinational gates
			    ❖ NAND, NOR, and XNOR
			  ○ Universal gates
			    ❖ NAND, NOR
				• 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
					6

Competency	Competency Level		Contents	Learning outcomes	Periods
				fabrication of any gate using universal gates	

	4.2	Simplifies logic expressions using laws of Boolean algebra and Karnaugh map	• Two state logic and Boolean Algebra
			• Postulates (Axioms)
			• Laws/theorems
			  o Commutative, associative
			• Distributive
			  o Identity, redundancy
			  o De Morgan's
			• Standard logical expressions
			  o Sum of products and product of sums
			  o Transform SOP into POS and vice versa
			• Simplify logic expressions using
			  o Boolean theorems
			  o Karnaugh map
				• Describes the need 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
					8

	4.3	Designs simple digital circuits using logic gates	• Truth tables and logic expressions for their designs (up to three inputs) • Digital circuit design	• Identifies situations to apply logic circuits in day to day life • Designs logic expressions and truth table for identified	6

Competency	Competency Level		Contents	Learning outcomes	Periods
				applications • Designs digital circuits	

	4.4	Explores how combinational Logic circuits are used in CPU and sequential circuits in physical memory	• Building blocks of CPU
			  o Half adder
			  o Full adder
			• Storing bits in digital circuits
			  o Feedback loop
			  o Flip-flops
				• Identifies the major building blocks of CPU
				• 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
					6

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	• Introduction to computer operating system
			• Evolution of OS
			• Main functions of an operating system
			  o Providing interfaces
			  o Process management
			  o Resource management
			  o Security and protection
			• Classification of operating systems
			  o Single user – single task
			  o Single user – multi task
			  o Multi user – multi task
			  o Multi-threading
				• 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
					4

Competency	Competency Level	Contents	Learning outcomes	Periods
		o Real time o Time sharing systems	operating system manages the resources of a computer • Classifies the operating systems based on their users and tasks	

	5.2 Explores how an operating system manages directories/folders and files in computers	• File types
		  o Need for file types (.exe, .jpg .txt, etc)
		• Directory and file organization
		  o File hierarchy
		  o File systems – FAT etc
		• File security
		  o Passwords and access privileges
		• File storage management
		  o Storage allocation
		    ❖ Contiguous allocation
		    ❖ Linked allocation
		    ❖ Indexed allocation
		• Defragmentation
		• Maintenance of secondary storage
		  o Need and outcome of disk formatting
			• 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
				6

Competency	Competency Level	Contents	Learning outcomes	Periods

			file security
			• Briefly explains
			   o Contiguous allocation
			   o Linked allocation
			   o Indexed allocation
			• Describes defragmentation and explains how it occurs	

	5.3 Explores how an operating system manages processes in computers	• Definition of process • Interrupts and interrupts handling • Process management • Process states • Process Transitions • Process control block • Context switching • Process schedulers	• 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	6

Competency	Competency Level	Contents	Learning outcomes	Periods
			scheduling policies • Compares long, short and medium term schedulers • Describes multi programming and its 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	

	5.4 Explores how an operating system manages the resources	• Memory management
		  o Memory Management Unit(MMU)
		  o Physical Memory
		  o Virtual memory
		• Input and output device management
		  o Device drivers
		  o Spooling
			• Briefly explains the need of memory management and Memory Management Unit (MMU)
			• Briefly explains the	

Competency	Competency Level	Contents	Learning outcomes	Periods
			virtual memory • Briefly explains paging and mapping • Briefly describes how an OS manages Input and output devices • Briefly describes device drivers • Briefly describes the need of device drivers • Briefly describes spooling • Installs appropriate device drivers when connecting a peripheral	6

Competency 6: Explores the data communication and computer networking technologies to share information effectively	6.1 Explores signals and their properties	• Signal Types
		   o Digital
		   o Analog
		 • Properties
		   o Amplitude
		   o Frequency
		   o Wave length
		   o Phase
		 • Propagation speed in a media
			• Graphically represents digital and analog signals and their properties
			 • Solves problems related to the relationship between signal properties
				4

	6.2 Explores signal	• Wires – Guided media (Twisted pair,	• Classifies media as	4

Competency	Competency Level	Contents	Learning outcomes	Periods

	transmission media	coaxial cable, Fiber optics etc.)
		• Free space – Unguided media
		• Properties
		  o Latency
		  o Bandwidth
		  o Noise
		  o Attenuation
		  o Distortion
		• Simple topology: point-to-point connection
			guided and unguided media
			• Describes how latency, bandwidth, noise, attenuation, and distortion affects signal transmission	

	6.3 Investigates how digital data is encoded using signal elements	• Agreeing on signal elements to represent data (a protocol)
		  o Two simple elements – two voltage levels (amplitudes)
		  o Other possibilities (briefly)
		    ❖ Frequency
		    ❖ Phase
		  o Changing speed of signal elements
		  o Need for synchronization
		    ❖ Timing/Clocks
		    ❖ Manchester encoding
		  o Handling errors
		    ❖ Example: Parity
			• 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
				4

Competency	Competency Level		Contents	Learning outcomes	Periods
				• Compares and contrasts the relationship between how fast the signal elements are changed and the bit rate in simple two voltage encoding and Manchester encoding • 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	• Public Switched Telephone Network
			  o Providing a circuit between two points that can carry analog voice
			• Modulation, Demodulation and Modems
			  o Encoding data using analog signal elements
			• Connecting two devices using Modems
				• 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	• All-to-all connections are impractical • A solution: Bus Topology	• Demonstrates the impracticality of	4

Competency	Competency Level		Contents	Learning outcomes	Periods

			multiple devices into a network is addressed	○ Simple
				○ Problem: Controlling access to the bus (media)
				• Other topologies
				  ○ Star
				  ○ Ring
				  ○ Mesh
				• Simplifying wiring
				  ○ Hubs
				  ○ Switches
					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 to simplify the wiring of a network and compares/contrasts their functionalities	

	6.6	Explores the role of Media Access Control (MAC) protocol	• Local Area Network (LAN)
			• Identifying devices
			  ○ Addresses – MAC addresses
			• Frames
			• Orderly access to the media
			  ○ Very simple protocol as an example – ALOHA
			  ○ Improvements from ALOHA to Ethernet
			• Broadcasting and Uni -casting messages
				• 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
					4

Competency	Competency Level	Contents	Learning outcomes	Periods
			protocols from ALOHA to Ethernet	

	6.7 Explores how the multiple networks are interconnected to form the Internet	• A device to connect two or more networks – gateway
		• Need for globally unique uniform addressing independent of MAC addresses and LAN technology
		   o IPv4 addresses
		   o Assigning IPs to networks
		      ❖ Sub-netting
		      ❖ Subnet masks
		      ❖ CIDR notation
		      ❖ Private IP addresses
		      ❖ DHCP
		   o Scarcity of IPv4 addresses and IPv6 as a solution(an overview)
		• Finding the path to the destination
		   o Routing and routers
		   o Packet switching
		• Best effort delivery
			• Explains the role of a gateway device in inter connecting two LANs
			• Explain the need for a uniform, MAC protocol independent addressing scheme and how IP addresses play that role
			• 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
				6

Competency	Competency Level	Contents	Learning outcomes	Periods
			• Explains packet switching and best effort delivery in IP networks	

	6.8 Explores the role of transport protocols in the Internet	• Delivering data from an application process to another application process
		  o Multiple applications at a host identified by an IP
		    ❖ Multiplexing – multiple end points at the same IP
		  o Ports and port numbers
		  o UDP
		    ❖ Properties
		    ❖ Applications
		  o TCP
		    ❖ Properties
		    ❖ Applications
			• Explains that it is not sufficient to deliver a message from one IP address to another by demonstrating that the communication is from process to a process
			• 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
				4

	6.9 Explores some applications on the	• Domain Name System (DNS) o IP addresses are hard to remember	• Describes the need for human friendly	4

Competency	Competency Level	Contents	Learning outcomes	Periods
	Internet	○ Human friendly names ○ Hierarchical name space ○ Each domain is responsible for managing the names under it ○ Top level domains - HTTP - Client Server model	names instead of IP addresses - Explains the role of DNS in translating names to IP addresses - Graphically represent the hierarchical and distributed structure of the DNS - 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	- TCP/IP model ○ Application ○ Transport ○ Internet ○ Host to network - OSI model ○ Application ○ Presentation ○ Session ○ Transport ○ Network ○ Data link ○ Physical	- 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

Competency	Competency Level	Contents	Learning outcomes	Periods

	6.11 Investigates the security aspects of the communication and protection of devices connected to the Internet	• Encryption and digital signature – basic idea
		  o Public Key
		  o Private Key
		  o Signing
		• Threats
		  o Viruses
		  o Trojans
		  o Malware
		  o Phishing
		• Protection
		  o Firewalls
		  o Antivirus software
		  o Education/ better awareness/ good practices
			• Identifies the need for confidentiality and authentication of messages and notes that the Internet does not provide
			• 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
				4

	6.12 Explores the role of ISPs and technologies used for connecting Home Networks to the Internet	• ISPs
		• Connecting to ISP
		  o Modems
		  o DSL/ADSL
		• A home LAN that uses private IPs
		  o Network Address Translation /Proxies
			• 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
				4

Competency	Competency Level		Contents	Learning outcomes	Periods
				private IPs	

Competency 7: Explores the systems concept and uses systems analysis and design methodology in developing information systems	7.1	Explores Characteristics of Systems	• System concept
			• Classification of systems
			   o Open and closed systems
			   o Natural and manmade systems
			   o Living and physical systems
				• Recalls the definition of systems
				• Lists and describes the characteristics of systems
				• Classifies and describes systems with examples
					4

	7.2	Compares and contrasts different types of manmade systems in terms of their objectives and functionality	• Information systems
			   o Office Automation Systems (OAS)
			   o Transaction Processing Systems (TPS)
			   o Management Information Systems (MIS)
			   o Decisions Support Systems (DSS)
			   o Executive Support Systems (ESS)
			   o Geographical information systems (GIS)
			   o Knowledge Management Systems (KMS)
			   o Content Management Systems (CMS)
			   o Enterprise Resource Planning Systems (ERPS)
			   o Smart systems
				• 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	• System Development Life Cycle models o Waterfall	• Lists and briefly describes system	08

Competency	Competency Level	Contents	Learning outcomes	Periods
	development models and methods	o Spiral o Agile o Prototyping ❖ Rapid Application Development (RAD) • System development methodologies o Structured o Object Oriented	development models • Investigates the applicability of each model • Lists and describes the stages of System Development Life Cycle (SDLC) in Waterfall model • 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)	• Introduction to SSADM • Stages of the system development life cycle	• 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	• Preliminary investigation o Identification of the problems in the current system o Suggest alternative solutions o Prioritizing information systems needs • Feasibility study o Technical feasibility	• Describes the tasks in preliminary investigation stage • Identifies information problems in an organization • Identifies priorities	4

Competency	Competency Level	Contents	Learning outcomes	Periods
		o Economic feasibility o Operational feasibility o Organizational feasibility	of the problems to be solved • Describes the need of feasibility study • Lists and briefly describe the types of feasibility	

	7.6 Uses different methods to analyze the current system	• Requirement analysis
		  o Functional requirements
		  o Non – functional requirements
		• Analytical Tools
		  o Business Activity Modeling
		    ❖ Business activity model
		  o Data Flow Modeling (DFM)
		    ❖ Data Flow Diagrams (DFD)
		    ❖ Elementary processes and Elementary Process Descriptions (EPD)
		    ❖ Document flow diagram
		  o Logical Data Modeling (LDM)
		    ❖ Logical Data Structure (LDS)
		• Business System Options (BSO)
			• 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
				18

28

Competency	Competency Level	Contents	Learning outcomes	Periods
			descriptions • Describes the need for business system options • Proposes business system options • Selects the most appropriate business system option	

	7.7 Designs the proposed system	• Logical design tools
		 ○ Logical Data flow modeling
		  ❖ Logical Data flow diagrams for proposed system
		  ❖ Elementary processes and elementary process description
		  ❖ User Interface design
		 ○ Logical Data modeling
		  ❖ Logical data structure for the proposed system
		 ○ Physical design of database
		  ❖ Table and record specifications
		  ❖ Data dictionary
		  ❖ Database design
			• 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	• Program development • Database development	• Lists the testing methods for a newly	6

Competency	Competency Level	Contents	Learning outcomes	Periods
		• Testing o Test cases o White box testing o Black box testing o Unit testing o Integrated testing o System testing o Acceptance testing	designed system • Describes the testing methods for a newly designed system	
	7.9 Deploys the developed system	• Deployment methods o Parallel o Direct o Pilot o Phase • Hardware/Software installation, data migration and user training • Review, support and maintenance	• Describes the methods of deployment of the developed system. • Describes the activities involved after implementation of a system	4
	7.10 Describes system implementation with off-the-shelf packaged systems	• 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	• 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	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			applications	
			• Identifies and describes differences between a given business process and features of off-the-shelf packages	
			• Maps business process activities onto work flow of the off-the-shelf packaged solution	
			• 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	• Data vs. information
		• Structured Vs. unstructured data
		• Definition of database
		• Database models
		   o Flat file system
		   o Hierarchical model
		   o Network model
		   o Relational model
		   o Object relational model
			• Distinguishes data and information
			• Defines database
			• Lists and briefly describes the database models
			• Compares and contrasts database models in terms of
				2

Competency	Competency Level	Contents	Learning outcomes	Periods
		• Comparison of database models	their features	

	8.2 Describes the main components of the relational database model	• Relations / Tables
		  o Attributes / Columns
		  o Tuples / Rows
		  o Relationships
		• Types of Constraints
		  o A NOT NULL Constraint
		  o A Unique Constraint
		  o A Primary Key Constraint
		  o A Foreign Key Constraint
		  o A (Table) Check Constraint
			• Defines relations / tables
			• Names and describes main components of a relational database
			• Describes the relationships in terms of relational database model
			• Briefly explains the types of constrains
				4

	8.3 Analyzes the main components of a database system	• Data Base Management System
		• Data definition language (DDL)
		  o Introduction to SQL
		  o Classification of SQL
		  o Creating, using relational database using DDL
		    ❖ Creating table
		    ❖ Alter table
		      - Inserting and deleting attributes
		      - Adding and deleting foreign key and primary key
		    ❖ Drop tables
		    ❖ Drop databases
		• Data manipulation Language (DML)
		  o DML Features in SQL
			• 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
				14

Competency	Competency Level	Contents	Learning outcomes	Periods

		❖ Inserting, modifying, retrieving, updating deleting data
		○ Select Query
		   ❖ Extracting rows and columns from single table
		   ❖ Extracting rows and columns from multiple tables using inner join operation
		   ❖ Insert Query
		   ❖ Update Query
		   ❖ Delete Query
			• 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 table
			• 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	

Competency	Competency Level	Contents	Learning outcomes	Periods
			query data according to the requirements	

	8.4 Designs the conceptual schema of a database	• ER (Entity Relationship) diagrams
		    o Entities, attributes
		    o Entity identifiers
		    o Relationships
		    o Cardinality
		 • Introduction to EER (Extended ER) diagrams
			• Describes ER diagram
			 • Describes the components of an ER diagram (entities, attributes)
			 • 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
				12

Competency	Competency Level	Contents	Learning outcomes	Periods
	8.5 Designs the logical schema of a database	- Definition of the logical schema - Database schema design - Relational schema - Relation instances - Candidate key - Primary key - Alternate key - Foreign key - Domain	- 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 to logical schema	- Entity transformation - Attribute transformation - Relationship transformation	- Describes the methods of transformation ER diagram to logical schema - Transforms ER diagrams (entity, attribute, relationships) to logical schema	6
	8.7 Normalizes database schema to improve performance	- Need for normalization- - Redundancies and anomalies ❖ Insert ❖ Update ❖ Delete - Functional dependencies - Full dependency - Partial dependency	- Describes the functional dependencies and categorizes them - Describes abnormalities of an improperly designed table when	6

Competency	Competency Level	Contents	Learning outcomes	Periods

		o Transitive dependency
		• Levels of normalization
		   o Zero normal form
		   o First normal form
		   o Second normal form
		   o Third normal form
			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 are reduced after the second normal form
			• 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	9.1 Uses problem-solving process	• Understanding the problem • Defining the problem and boundaries • Planning solution • Implementation	• Describes the steps of problem solving process • Implements the solution	2

Competency	Competency Level		Contents	Learning outcomes	Periods
algorithms					
	9.2	Explores the top down and stepwise refinement methodologies in solving problems	- Modularization - Top down design and stepwise refinement - Structure charts	- 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	- Algorithms - Flow charts - Pseudo codes - Hand traces	- Briefly describes algorithms - Identifies the standard symbols used to draw flow charts - 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	6
	9.4	Compares and Contrasts different programming paradigms	- Evolution of programming languages - Programming paradigms - Imperative languages - Declarative languages - Object oriented languages	- Describes the evolution of programming language in terms of generations - Compares and	2

Competency	Competency Level		Contents	Learning outcomes	Periods
				contrasts imperative, declarative, object oriented languages	

	9.5	Explores the need of program translation and the type of program translators	• Need of program translation
			• Source program
			• Object program
			• Program translators
			  ○ Interpreters
			  ○ Compilers
			  ○ Hybrid approach
			• Linkers
				• 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 function of linkers
					2

	9.6	Explores integrated development environment (IDE) to identify their basic features	• Basic features of IDE
			• Instructions to use
			  ○ Opening and saving files
			  ○ Compiling, executing programs
			• Debugging facilities
				• Identifies the basic features of IDE
				• Practices the instructions to
				  ○ Open and save files
				  ○ Compile, execute programs
				• Uses the debugging facilities in IDE
					4

	9.7	Uses an imperative programming language to encode algorithms	• Structure of a program • Comments • Constants and Variables • Primitive data types • Operator categories	• Identifies the structure of a program • Uses comments to identify the usage of	10

Competency	Competency Level	Contents	Learning outcomes	Periods

		o Arithmetical, relational, logical, bitwise
		• Operator precedence
		• Input / output
		  o Input from keyboard
		  o Output to standard devices
			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 operators
			• Writes programs with the facilities of input from keyboard and output to standard devices	

	9.8 Uses control structures in developing programs	• Control Structures
		  o Sequence
		  o Selection
		  o Repetition
		    ❖ Iteration
		    ❖ Looping
			• Briefly describes control structures
			• Lists and briefly describes the types of control structures
			• Uses control structures appropriately in programming
			• Applies nested
				12

Competency	Competency Level	Contents	Learning outcomes	Periods
			control structures in programs	

	9.9 Uses sub-programs in programming	• Types of subprograms
		   o Built in
		   o User defined
		     ❖ Structure
		     ❖ Parameter passing
		     ❖ Return values
		     ❖ Default values
		     ❖ Scope of variables
			• 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 life time
			 • 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
				10

	9.10 Uses data structures in programs	• Data structures
		   o Strings
		   o Lists
			• Briefly explains the use of data structures	8

Competency	Competency Level		Contents	Learning outcomes	Periods
			o Tuples o Dictionaries	• Uses relevant data structures in programming	
	9.11	Handles files and databases in programs	• File handling o Basic file operations	• Uses basic file operations (open, close, read write and append)	6
	9.12	Manages data in databases	• Connecting to a database • Retrieve data • Add, modify and delete data	• Embeds SQL statements in programming languages to retrieve, add, modify and delete data	4

	9.13	Searches and sorts data	• Searching techniques
			  o Sequential search
			• Sorting techniques
			  o Bubble sort
				• Uses sequential searching technique appropriately
				• Implements bubble sort technique appropriately
					4

Competency 10: Develops websites incorporating multi-media technologies (using HTML 5)	10.1	Explores the need for web	• The world wide web (www)
			• Types of web sites
			  o Information, news
			  o Personal, educational, commercial, Research
			  o Web portals
				• Describes www
				• Analyses the systematic arrangements of contents and structure of a web
					8

	10.2	Analyses user requirements(multimedia	• Defining the objectives of a website • Contents to be displayed	• Creates effective and appropriate	4

Competency	Competency Level	Contents	Learning outcomes	Periods
			information layout of a website • Identifies the web pages of a website • Identifies the contents of a web page • Identifies navigation structure	
	10.3 Identifies appropriate HTML tags to design a single web page	• Building blocks of a web page 　o Page definition 　　❖ <html></html> 　o Head section 　　❖ <head></head> 　　❖ <title></title> 　o Body section 　　❖ <body></body> • Background color 　o Text formatting 　　❖ <h1>…<h6>tags 　　❖ <p></p> 　　❖ 　　❖ Underline, bold, italic 　　❖ 　　　– Size and color • Adding comments	• Analyses the arrangement of contents of a web page • Analyses the organization of contents in a web page • Creates a simple web page	4
	10.4 Uses HTML to create linked web pages	• Contents of a website 　o Home page 　o Linked pages 　o Hyperlink 　　❖ Different sections of the same	• Explains hypertext markup language • Identifies the standards of HTML • Saves the source	16

Competency	Competency Level	Contents	Learning outcomes	Periods

		page(book mark)
		 ❖ Different pages of a same site(local link)
		 ❖ Pages of different sites (External link)
		 • Lists
		   o Ordered lists
		   o Unordered lists
		   o Definition lists
		 • Image
		 • Tables
		   o <table></table>
		   o <th></th>
		   o <tr></tr>
		   o <td></td>
		   o <caption>
		   o Merging columns and rows
		 • Multimedia objects
		   o Audio
		   o Video
			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	

	10.5 Uses Style sheet to change the appearance of web pages	• Introduction to style sheet
		 • CSS
		   o Syntax, comments
		 • CSS selectors
		   o element, id, class, group
		 • Ways of inserting CSS
		   o Internal, external, inline
		 • Appearance formatting
		   o Background (color, image)
		   o Text and fonts
		   o Links
			• 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
				8

Competency	Competency Level	Contents	Learning outcomes	Periods
		o Lists o Tables	improve the appearance • Applies various CSS formatting in HTML web pages to improve the appearance	
	10.6 Uses an authoring tool to create web pages	• Introduction to web authoring tools	• Briefly explains web authoring tools • Creates web pages using a web authoring tool	10

	10.7 Creates dynamic web pages using PHP and MySQL	• Introduction to dynamic web pages
		• Embedding PHP code into web page
		  o Variables
		  o Arrays
		  o Control structures
		  o Functions
		  o Database connectivity
		  o Working with databases
		• Forms
		  o Input element
		    ❖ Type attribute
		    ❖ Name attribute
		    ❖ Value attribute
		  o Text input (Password)
		  o Radio buttons
		  o Check box
		  o Selection
			• Defines dynamic web pages
			• Creates data source and enters data
			• Creates PHP code to save/retrieve data to and from MySQL
			• Develop simple web based information systems
				6

Competency	Competency Level	Contents	Learning outcomes	Periods

		o Submit buttons
		o Reset button
		o Action attribute
		o Method attribute
		   ❖ Get
		   ❖ Post
		o Grouping form data using <fieldset> tag
		o 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		

	10.8 Publishes and maintains web sites	• Local publishing
		  o Own computer, intranet
		• Internet publishing
		  o Connecting to the web Service provider
		  o Publishing web Pages on web server
		• Factors affecting performance of website
			• 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	Competency Level	Contents	Learning outcomes	Periods

Competency 11:
 	
Explores IoT and identify the building blocks of embedded systems to develop simple applications
	11.1 Acquires the knowledge of basic building blocks of embedded systems	• Microcontroller - Based Development Systems (Arduino and other similar systems)
		 ○ Introduction
		  ❖ Microcontroller based Development Systems vs. microprocessor based systems
		 ○ Features
		  ❖ Analog Input
		  ❖ Digital Input
		  ❖ Microcontroller
		  ❖ Digital Output
		  ❖ Receiver and Transmitter Pins
		  ❖ Communication Port
		  ❖ Power supply
		 ○ Connect to the computer
		  ❖ USB Connectivity
		  ❖ IDE Software (code editor, compiler and programmer)
		 ○ Simple applications
		  ❖ Switch on/off a LED
		  ❖ Sensing ambient light intensity with a LDR and switching a LED on and off depending on the light intensity
		  ❖ Sensing the room temperature with temperature sensor and switching a fan on and off
			● Identifies and lists Microcontroller based Development Systems
			● Describes available features on Microcontroller based Development Systems
			● Identifies necessary software and download them from the Internet to design and write programs into Microcontroller based Development Systems
			● Develops simple applications using to Microcontroller based Development Systems
			 − Switch on/off LEDs on ambient light intensity
			 − Run a fan on high temperature
			 − Door open/close detection using a read switch
				8

46

Competency	Competency Level	Contents	Learning outcomes	Periods
		depending on the temperature ❖ Detection of opening/closing a door using a read switch		
	11.2 Explores the Internet of Things (IoT) to create a simple application	● Introduction to IoT ○ Definition ○ Needs ○ IoT applications ○ Enabling technologies ● Simple IoT application to construct a remote switch	● 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 light ● Uses IoT based system while knowing the social	7

Competency	Competency Level	Contents	Learning outcomes	Periods
			and security consequences of IoT	

Competency 12: Explores applicability of ICT to business organizations and the competitive marketplace	12.1 Explores the role of ICT in the world of business	• Digital economy
		  o New business methods in digital economy
		    ❖ Reverse auctions
		    ❖ Group purchasing
		    ❖ e-Marketplace
		• Pure brick, brick and click, and pure click organizations
		• Business functions and the role of ICT
		  o Accounting and ICT
		  o Human resource and ICT
		  o Production and ICT
		  o Marketing & sales and ICT
		  o Supply chain management and ICT
		  o Business communication and ICT
		  o Secure payment mechanisms
		    ❖ Payment gateways
		    ❖ Secure credit card payments
		    ❖ Third party systems
		      – PayPal etc
		    ❖ Mechanisms
			• 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

Competency	Competency Level	Contents	Learning outcomes	Periods

		– Data encryption
		– Micro credit payments (bit coin etc.)
		• Threats and opportunities in ecommerce
		  o Privacy
		  o Product commercialization		

	12.2 Analyses the relationship between ICT and business operations	• E-Commerce and e-business
		  o The scope of e-commerce and e-business
		  o Types of e-business transactions
		    ❖ B2B, B2C, C2C, C2B, B2E, G2C
		• E-Business
		  o Virtual storefronts
		  o Information brokers
		  o Online marketplace
		  o Content provider
		  o Online service provider
		  o Portal
		  o Virtual Community
		• Advantages and disadvantages of e-business
			• Distinguishes the e-commerce and e-business
			• 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
				4

	12.3 Analyses the ICT in terms of generating and delivering an improved products and services to consumers	• E-marketing
		  o Concepts of marketing
		  o Use of ICT in marketing
		    ❖ Web advertising etc
		• Databases in marketing
		  o Predicting customer behavior with AI tools and techniques
			• Defines e-marketing
			• Identifies the role of ICT in e-marketing
			• Investigates the usage of database in marketing
				4

Competency	Competency Level	Contents	Learning outcomes	Periods
		o Gaining competitive advantages through ICT • Mobile Marketing	activities to improve the product and services according to the requirements of the customers • Identifies the ways of gaining competitive advantages using ICT	
Competency 13: Explores new trends and future directions of ICT	13.1 Explores new trends and future directions in computing	• Intelligent and emotional computing • Artificial intelligence • Man-machine coexistence • Machine to machine coexistence	• Describes intelligent and emotional computing. • Explains artificial intelligences • Appreciates man-machine coexistences	4
	13.2 Explores the fundamentals and applications of agent technology	• Software agents • Multi-agent systems • Applications of Agent systems	• Briefly describes software agents and their characteristics • Briefly describes multi-agent systems and their characteristics • Identifies the applications of agent systems	4

Competency	Competency Level	Contents	Learning outcomes	Periods
	13.3 Analyzes the existing models of computing and proposes new models	• Beyond von-Neumann computer • Nature inspired computing • Biology inspired computing • Fundamentals of quantum computing • Applications	• Predicts the technologies beyond von-Neumann computers	4

Competency 14: Designs and Implements a simple Information system project	14.1 Conducts a project on designing an information system	• Examples of projects
		• Stakeholders
		  o Roles and responsibilities of the following stakeholders:
		    • senior management
		    • customer/client
		    • user
		    • project manager
		    • team member
		    • peer reviewer
		    • supplier
		• Project planning
		  o The phases of the project
		  o The activities to be carried out in each phase
		  o Start date and end date of each activity
		  o Dependencies
		  o Resources required for each activity
		  o Dates of key milestones
		  o Potential risks, their effect on the plan and how their impact can be minimized
			• Identifies the characteristics and reasons of projects with examples
			• Identifies the role of stakeholders
			• Identifies the reasons of project plan and the planning criteria
			• Identifies a simple problem to be carryout as a project
			• Prepares project proposal
			• Presents the proposal
			• Organizes the project
			• Carryout the project according to the SDLC
				25
				
				One period per week for a duration of one year

Competency	Competency Level	Contents	Learning outcomes	Periods

		○ Gantt charts
		 • Identification of a simple problem for the project
		 • Project proposal
		   ○ Proposal preparation
		   ○ Getting approval
		 • Project organization
		   ○ Storing documents relating to a project (project folder)
		   ○ Protecting information from accidental damage
		   ○ Communicating with stakeholders
		   ○ Reporting on progress
		   ○ Holding reviews
		 • Phases of a project
		   ○ Preliminary investigation
		   ○ Feasibility study
		   ○ Requirement analysis
		   ○ Design
		   ○ Coding
		   ○ testing
		   ○ Documentation
			phases
			 • Handovers the outcomes of each phase to documentation after evaluate by the teacher	

	14.2 Implements and demonstrates the Information system	• Project presentation and demonstration of the system	• Presents the finished project and demonstrates the system to all the class	05

10.0 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.**

Competency 8:   Designs and develops database systems to manage data efficiently and
                         effectively

Competency Level 8.1: Learns the basics of information and data, and the need for databases

Time: 02 periods

Learning Outcomes:

- Distinguishes data and information
- Defines database
- Lists and briefly describes the database models
- Compares and contrasts database models in terms of their features

Contents:

- Data vs. information
- Structured Vs. unstructured data
- Definition of database
- Database models
    - Flat file system
    - Hierarchical model
    - Network model
    - Relational model
    - Object relational model
- Comparison of database models

Concepts and terms to be highlighted:

- Data
- Information
- Need for transformation data (unstructured) into information (structured)
- Categorization of data into group(tables)
- Advantage of databases and there feathers.
- Deferent types of database models
    - Database models
        - Flat file system
        - Hierarchical model
        - Network model
        - Relational model
        - Object relational model
    - Comparison of database

Guidance for lesson plans:

- Divide the students into groups.
- Ask groups to collect data from particular instance.
    - Ex: Select   twenty books randomly selected in school library find the detail information of
      each books (Title, Publication date, ISBN No, Author, etc.)

- Ask the groups to put the collect data into meaningful group

- o Ex: group the books name according to subject
- Discuss with the student which data or information is more useful.

- Discuss the organizing of data in some order and how efficient to search for an item in a sequence
  - Ex: 1. according to alphabetical order in author's name
           2. Search for an item when there in order (author name or subject name).
- Discuss the importance of databases
- Discuss t advantages and features of database
- Discuss the deferent database models
- Compare the different database models

Guidance for assessments and evaluations:

- Divide students into group and ask them to find real world examples and identify data and information and categories into a suitable tables.
- Ask the group to present their findings
- Ask student to identify witch category their example belong to
- Ask the student group to prepare a presentation about the advantages and features of database

Quality inputs:

Library access facility

Presentation

Competency Level 8.2: Describes the main components of the relational database model

Time: 04 periods

Learning Outcomes:

- Defines relations / tables
- Names and describes main components of a relational database
- Describes the relationships in terms of relational database model
- Briefly explains the types of constrains

Contents:

- Relations / Tables
    o Attributes / Columns
    o Tuples / Rows
    o Relationships
- Types of Constraints
    o A NOT NULL Constraint
    o A Unique Constraint
    o A Primary Key Constraint
    o A Foreign Key Constraint
    o A (Table) Check Constraint

Concepts and terms to be highlighted:

- Relations / Tables

    o Attributes / Columns

    o Tuples / Rows

    o Relationships

- Types of Constraints

    o A NOT NULL Constraint

    o A Unique Constraint

    o A Primary Key Constraint

    o A Foreign Key Constraint

    o A (Table) Check Constraint

Guidance for lesson plans:

- Provide a print out of created tables with relationships and discuss with the student the features (table, attribute, tuples, and relationships) of them.
- Divide students into groups
- Provide print outs with improperly created tables and well-designed tables.
- Compare and discuss the above table.
- Request to group to identify the inappropriate design of tables.

- Discuss the needs for constraints for the design
- Explain the type of constraints for the design.

Guidance for assessments and evaluations:

- Provide printouts of created tables and relational schemas to students and ask them to identify the attributes, tuples, relationships and the applied constraints.
- Provide printouts of created tables and relational schemas to students and ask them to identify their shortcoming.

Quality inputs:

- Printouts of created tables and relational schemas, presentation

Competency Level 8.3: Analyzes the main components of a database system

Time: 14 periods

Learning Outcomes:

- 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 table
- 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

Contents:

- Data Base Management System
- Data definition language (DDL)
  - Introduction to SQL
  - Classification of SQL
  - Creating, using relational database using DDL
    - ❖ Creating table
    - ❖ Alter table
      - Inserting and deleting attributes
      - Adding and deleting foreign key and primary key
    - ❖ Drop tables
    - ❖ Drop databases

- Data manipulation Language (DML)
  - DML Features in SQL
    - ❖ Inserting, modifying, retrieving, updating deleting data
  - Select Query
    - ❖ Extracting rows and columns from single table
    - ❖ Extracting rows and columns from multiple tables using inner join operation
    - ❖ Insert Query
    - ❖ Update Query
    - ❖ Delete Query

Concepts and terms to be highlighted:

- Database management systems
- Understand how databases are implemented and used in practice
- Selection and use of Primary Key and Foreign Key
- DDL (Data Definition Language) : The language used to create the database structure

- The functions of DDL commands – Examples - Create, Drop, Alter, etc.
- DML (Data Manipulation Language): The language used to manipulate data
- The functions of DML Commands: Examples – Insert, modify, delete et
- Database Query: Standard commands used to query a database according to given conditions. Example – Finding the names of students living in a particular town

Guidance for lesson plans:

- Introduce the concept of DBMS
- Discuss the functions of DBMS with examples
- Distribute a practical sheet of command (DDL and DML) summary and request students to practice the commands
- Discuss the criterion for selecting smelting and appropriate the of keys (primary and foreign)
- Discuss some sample queries for a given condition
- Provide some conditions and ask students to make appropriate queries satisfying the conditions

Guidance for assessments and evaluations:

- Provide the students with a worksheet to create a DBMS and to use it.
- This worksheet should contain all the commands students learnt. In addition, it should contain few logical queries that could be done on the DBMS.

Quality inputs:

- Computers with DBMS software, Practical sheets, Worksheets, Presentations

Competency Level 8.4: Designs the conceptual schema of a database

Time: 12 periods

Learning Outcomes:

- Describes ER diagram
- Describes the components of an ER diagram (entities, attributes)
- 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

Contents:

- ER (Entity Relationship) diagrams
    - Entities, attributes
    - Entity identifiers
    - Relationships
    - Cardinality
      Introduction to EER (Extended ER) diagrams

Concepts and terms to be highlighted:

- Decomposes a real world systems into logical subsystems (relations) and to connect (relationship) them logically

- ER (Entity Relationship) diagrams
    - Entities
    - Attributes
    - Relationships
    - Cardinality
- Introduction to EER (Extended ER) diagrams

Guidance for lesson plans:

- Divide students into groups and provide a scenario to each group
- Ask the group to identify the nouns and verbs in the provided scenario
- Request the group to identify the nouns which are independent and dependent
- Request the group to appreciate how independent nouns become Entities and dependent nouns become the description (attributes) of the independent nouns.
- Request group to appreciate how the verb becomes a connections (relationship) between two independent nouns(Entities)
- Request group to identify the connection between entities and identify the multiple number of connections between the attribute of two entities.

- Discuss that witch connection are called the cardinality (one to one, one to many, many to many)
- Request student to identify why ER diagram for not suitable for specialization and generalization of entity.
- Discuss Extended Entity Relationship (EER) diagram.
- Construct and discuss some examples of ER diagram and EER diagrams.

Guidance for assessments and evaluations:

- Request student to identify the entities and relationships for a given scenario.
- Request student to construct ER or EER diagram.
- Request student to identify the cardinality ratios and illustrate it properly in to constructed diagram.

Quality inputs:

Scenarios, illustration from web and internet sources (ex: YouTube)

Competency Level 8.5: Designs the logical schema of a database
Competency Level 8.6: Transforms ER diagrams to logical schema

Time: 12 periods

Learning Outcomes:

- Defines logical schema of a database
- Describes relational schema
- Describes relational instances
- Briefly describes Candidate key, primary key, alternate key and foreign key
- Describes the methods of transformation ER diagram to logical schema
- Transforms ER diagrams (entity, attribute, relationships) to logical schema

Contents:

- Definition of the logical schema
- Database schema design
    - o Relational schema
    - o Relation instances
    - o Candidate key
    - o Primary key
    - o Alternate key
    - o Foreign key
- Domain
- Entity transformation
- Attribute transformation
- Relationship transformation

Concepts and terms to be highlighted:

- Logical schema - tabular structure of representing ER diagram in order to visualize the entities, relationships and relationship keys in a more design oriented way.
- Database schema design tabular method of representing a scenario with relations, relationships and keys.
- Relational schema is another way of drawing the schema diagram.
- Relation instances are the values of the attributes at a given instances.
- Keys are the specific attribute of entities that connect the attributes.
- Keys
    - o Candidate key
    - o Primary key
    - o Alternate key
    - o Foreign key
- Domain is the allowed values (types, values, length) of an attribute
    - o Ex: in the calendar year 12 months are allowed.

Guidance for lesson plans:

- Divided the student into group
- Guide the groups to convert the construct to ER diagram into relational schema.

- Explain each types keys in the attributes and discuss the appropriate usage of them
- Guide the student to identify and mark the primary key and foreign key in relational schema
- Guide to identify domain of attributes.

Guidance for assessments and evaluations:

- Ask the student to Construct ER diagram for a given scenario
- Ask to student to convert to constructed ER diagram to relational schema and marks the primary and foreign key appropriately.

Quality inputs:

Scenarios, presentation with ER diagram in class, suitable web sites and web facilities. (Ex: YouTube)

Competency Level 8.7: Normalizes database schema to improve performance

Time: 06 periods

Learning Outcomes:

- 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 are reduced after the second normal form
  Explains the abnormalities which are reduced after the third normal form

Contents:

- Need for normalization-
  - Redundancies and anomalies
    - Insert
    - Update
    - Delete
- Functional dependencies
  - Full dependency
  - Partial dependency
  - Transitive dependency
- Levels of normalization
  - Zero normal form
  - First normal form
  - Second normal form
  - Third normal form

Concepts and terms to be highlighted:

- Normalization – improves the performance of a database in inserting, updating and deleting data by reducing redundancies and anomalies.
- Redundancy, Anomaly
- Functional Dependency (FD) – FD is a constraint that describes the relationship among attributes in a table
- Levels of Normalization
  - Zero Normal Form
  - First Normal Form
  - Second Normal Form
  - Third Normal Form

Guidance for lesson plans:

- Divide the students into groups
- Provide the students with a zero normalized tables and ask the groups to identify the shortcomings
- Discuss the identified shortcomings and introduce the important terms like redundancy, anomaly and dependency
- Discuss how redundancy, anomaly and dependency can be reduced using normalization.
- Create some examples to introduce different levels of normalization step by step.

Guidance for assessments and evaluations:

- Provide students with a printout with zero normalized tables and ask them to find the shortcomings and normalize up to third normalized form step by step.

Quality inputs:

- Printouts with zero normalized tables, presentations

Competency 9:   Develops algorithms to solve problems and uses python programming language to encode algorithms

Competency Level 9.1:   Uses problem-solving process
Competency Level 9.2:   Explores the top down and stepwise refinement methodologies in solving problems

Time: 06 periods

Learning Outcomes:

- Describes the steps of problem solving process
- Implements the solution Briefly describes Candidate key, primary key, alternate key and foreign key
- Uses stepwise refinement methodology to solve problems
- Draws structures charts to illustrate a solution for a system

Contents:

- Understanding the problem
- Defining the problem and boundaries
- Planning solution
- Implementation
- Modularization
- Top down design and stepwise refinement
- Structure charts

Concepts and terms to be highlighted:

- Appreciate the process of problem solving, using critical thinking and logical process
- Design a system by breaking the system into small subsystem and connecting them logically
- Structure charts
- Illustrate how structure charts can be used to show the breakdown of a system to its lowest manageable levels

Guidance for lesson plans:

- Divide the students into groups
- Provide simple problems to each group and ask them to discuss the problem solving process and present it
- Discuss the systematic process of problem solving
- Ask each group to identify a problem to solve
- Ask the group to break the problem into small sub parts (subsystems)
- Discuss the top down and stepwise refinement methodology in problem solving
- Introduce Structure Charts

Guidance for assessments and evaluations:

- Provide a problem and ask the students to write down the steps to solve it

- Ask the student to draw the Structure Chart for the problem

Quality inputs:

- Printout with problems, presentations

Competency Level 9.3:   Uses algorithmic approach to solve problems

Time: 06 periods

Learning Outcomes:

- Briefly describes algorithms
- Identifies the standard symbols used to draw flow charts
- 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

Contents:

- Algorithms
  - Flow charts
  - Pseudo codes
  - Hand traces

Concepts and terms to be highlighted:

- Algorithm
- Algorithm is the step by step process to be followed in solving a problem
- Sequence
- Selection
- Repetition
- Flow chart
- Flow chart is a diagram used to represent an algorithm
- Pseudo code
- Pseudo code is a high level description used to represent an algorithm

Guidance for lesson plans:

- Provide a problem and ask the students to write down the solution in stepwise
- Discuss their stepwise solution and introduce the term algorithm and its representations (flow chart and pseudo code)
- Provide some situations of sequence, selection, repetition and discuss each of them
- Provide some sample problems and discuss how to show their solutions in flow charts and pseudo code
- Provide some problems and ask the students to create algorithms in both flowcharts and pseudo code and present it

Guidance for assessments and evaluations:

- Provide problems involving sequence only, selection, iteration selection and iteration and ask the students to create algorithms in both flow chart and pseudo code
- Provide flow charts and ask the students to find the output of the problem

Quality inputs:

- Printouts with flowcharts and pseudo code, presentations

Competency Level 9.4:   Compares and Contrasts different programming paradigms

Time: 02 periods

Learning Outcomes:

- Describes the evolution of programming language in terms of generations
- Compares and contrasts imperative, declarative, object oriented languages

Contents:

- Evolution of programming languages
- Programming paradigms
  - o Imperative languages
  - o Declarative languages
  - o Object oriented languages

Concepts and terms to be highlighted:

- Programming languages
- Evaluation of programming languages
- Programming paradigms
- The specific style of programming is called Programming Paradigms
- According to the paradigms of programming, the programming languages can be classified as follows
- Imperative languages
- Declarative languages
- Object oriented languages

Guidance for lesson plans:

- Divide the student into groups
- Ask each group to search about the evolution of programming language in internet and present their findings.
- Discuss programming paradigms. (imperative, declarative and object oriented)

Guidance for assessments and evaluations:

- Divide the student into groups
- Ask each group to prepare a presentation on evolution of programing languages and present it.
- Ask student to find at least one language under each programing paradigm.

Quality inputs:

- Internet access facilities
- Presentations
- Computers with presentation software

Competency Level 9.5:   Explores the need of program translation and the type of program translators

Time: 02 periods

Learning Outcomes:

- 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 function of linkers

Contents:

- Need of program translation
- Source program
- Object program
- Program translators
  - Interpreters
  - Compilers
  - Hybrid approach
    Linkers

Concepts and terms to be highlighted:

- Appreciating that a computer programs are executable in binary format only (binary files)
- Identifying the difference between source program and object (executable) program
- Appreciating the need for translating (interpreting/ compiling) the computer programs written in high level languages (source program) to binary format (executable program)
- Appreciating the difference between compiling and interpreting
- Compiling Process – Translating the complete source program as a whole to equivalent binary format and make it as one executable program
- Interpreting Process – Translating the source code line by line to equivalent binary format at the time of execution
- Hybrid Approach – Combining of interpreting and compiling process
- Appreciating how linkers do dynamic translation/ compiling
- Source Program, Object Program, Interpreter, Compiler, Linker, Loader

Guidance for lesson plans:

- Show a source file and the corresponding object file of a computer program, and ask students to identify the differences in them, and discuss.
- Discuss the process of translating a natural language
- Discuss the process of translating a computer programming language to make students appreciate the fact that some kind of interface (translator) is necessary in order for the computer to understand what is written (commands) by humans
- Show an example source program of an interpreting language and execute it and demonstrate that interpreting and executing are happening line by line
- Show an example source program of a compiling language and execute it and demonstrate that compiling and executing are happening at separate times
- Show the system overview of an example process where both an interpreting and compiling are done (Hybrid Approach)

o   Discuss the function of Linkers/ Loaders and how they function using a program flow diagram

Guidance for assessments and evaluations:

o Provide questions like what is a compiler/ interpreter? Why is it necessary to use a Compiler/ Interpreter? etc.

Quality inputs:

o Computers with python programming language, Presentations

Competency Level 9.6:   Explores integrated development environment (IDE) to identify their basic features

Time: 04 periods

Learning Outcomes:

- Identifies the basic features of IDE
- Practices the instructions to
  o Open and save files
  o Compile, execute programs
- Uses the debugging facilities in   IDE

Contents:

- Basic features of IDE
- Instructions to use
  o Opening and saving files
  o Compiling, executing programs
- Debugging facilities

Concepts and terms to be highlighted:

  o Appreciate the fact that to do programing, it is necessary to have software like Editors, Compilers, Debuggers and/ or Frameworks (IDEs)
  o Appreciate the fact that IDEs are comprehensive software containing Editors, Compilers, and Debuggers etc.
  o Editors, Compilers, Debuggers, IDEs.

Guidance for lesson plans:

  o Show an IDE of a particular language, and explain & discuss the features (Editing, Compiling, Debugging etc. functions)

Guidance for assessments and evaluations:

  o Provide a IDE of a particular language and ask the students to identify the its' features

Quality inputs:
  o Computers with python software
  o Presentations

Competency Level 9.7: Uses an imperative programming language to encode algorithms

Time: 10 periods

Learning Outcomes:

- 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 operators
- Writes programs with the facilities of input from keyboard and output to standard devices

Contents:

- Structure of a program
- Comments
- Constants and Variables
- Primitive data types
- Operator categories
  - Arithmetical, relational,
    Logical, bitwise
- Operator precedence
- Input / output
  - Input from keyboard
  - Output to standard devices

Concepts and terms to be highlighted:

- Appreciate the fact that a computer programs should contain all the commands explicitly and they should be constructed according to a standard structure
- Appreciate the fact that a structure should necessarily have an identifier (a header), definitions (declaration of variables, constants etc.), a body (where the processing is done), and an output section (output commands) in that order
- Appreciate the need for adding non executable statements (comments) in order to understand the functions of the statement at a later time or by another person
- Appreciate the difference between constants and variables, and that they are necessary in order to do calculations in the body of a program (Example: In y= mx + c, m and c are constants and x is a independent variable, x, c, and m determines the value of y, the dependent variable)
- Appreciate that each language has its' own data types
- Identify the types of data of the language being used
- Appreciate that data may be operated by an operation to get an output that combines or compares two or more data items
- Identify the categories of operators: Arithmetic, Relational, Logical, Bitwise
- Appreciate the fact that any equation has operators of more than one category and they need to be given an order of evaluation (precedence) according to a standard method
- Appreciate the fact that in any system, there should be an input device to input data in to a processing unit to process the data, and an output device to display the processed data, and there should be statements to input data and output data according to a specific language

o Appreciate the data input and the need for type conversion of input data
o Data, Data types, Variables, Constants, Comments, Operators, Operator Precedence, Input/ Output

Guidance for lesson plans:

o Discuss the need for a structure of any Document (Letter, Essay etc.) – Header, Body, Conclusion
o Discuss the need for a structure for a computer program
o Show a sample program (in the programming language being taught) discuss the structure of the program: Program identifier, Declaration of variables & constants, Body (where the processing is done), and Output section (output commands) in that order
o Divide students into groups
o Provide the groups with a simple sample program in the programming language being taught (without comments) and make them realize that it is difficult to know what the program statements do without a comment in natural language at the end of the statement
o Discuss the need for comments in programs, as well as the syntax of the programming language being taught
o Give the equation y= mx + c, where c and m are constants and x is an independent variable, x, c and m determine the value of y, the dependent variable, and the groups to identify their (c, x and y) nature and behavior
o Discuss and introduce the nature and characteristic constants and variables and how they are declare and use (their syntax) in the programming language being taught
o Discuss the concept of data types and different data types of the language being used, and their syntax in the programming language being taught
o Show some sample programs that contain different data types and ask students to identify them
o Ask student groups to write a simple program of few lines, compile it and run. If there are compiling errors, ask students to identify them. If there are no compiling errors, ask them to introduce an error and study the error report after compiling
o Discuss commonly used operators
o Discuss and explain the operators and their syntax of the language being taught
o Ask student groups to write simple programs which contain as many operators (arithmetic, relational, logical, and bitwise) as possible
o Give an example equation containing operators of different precedence and ask the groups to solve the equation and get the answer
o Discuss with students the solving procedure (according to precedence) and how there can be different answers in a different precedence
o Discuss the importance of a standard precedence of operators, and introduce the precedence of operators of the language being taught
o Ask student groups to write simple programs to input data, do some processing and display

Guidance for assessments and evaluations:

o Provide simple equations and ask students to write a program with comments to read data from keyboard/ mouse and display the results
o Check whether students have followed the correct structure when writing the program
o Check whether the comments written by the students are appropriate
o Ask students to develop programs to some sample real world situations (Example: Converting Farenheight to Centigrade using C=(F-32)*5/9) and ask students to identify the variable(s) and constant(s) in it ask the groups to write a simple program to input different input values in Farenheight and display the corresponding Centigrade value on a display
o Write an equation with many data types (integer, floating point, string, date etc.) and ask students to categorize them into types
o Ask students to identify different operators in the equation and the correct precedence

o Give a complex equation and ask students to use brackets in cases where the compiler is not able to identify the precedence by default

Quality inputs:

  o Computers with python programming language
  o Sample programs
  o Presentations

Competency Level 9.8:   Uses control structures in developing programs

Time: 12 periods

Learning Outcomes:

- 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

Contents:

- Control Structures
  - Sequence
  - Selection
  - Repetition
    - Iteration
    - Looping

Concepts and terms to be highlighted:

- Appreciate the need for control structures to execute a program appropriately
- Appreciate the fact that when executing a program, the commands are executed sequentially
- Appreciate the fact that program could execute in separate paths (two or more) according to a condition (If, If and Else)
- Appreciate the fact that some sequences need to be repeated (pre-determined or post- determined number of times – Iteration and Looping)
- Appreciate the fact that there can be sub repetitions inside a repetition (Nested Loops)
- Control structures – sequence, selection. repetitions – iteration, looping

Guidance for lesson plans:

- Show a complex program and explain the structure highlighting Conditional Statements.
- Divide the students into groups
- Ask student groups to get the output of a program and compare it with the source code and identify that the output is in sequence with the corresponding input commands in case of sequential (non-conditional and non-repetitive) execution
- Ask student groups to write a program to solve a simple problem using conditional statements (Example: To apply a 30 per cent discount for all purchases of more than 400,000 Rs., else no discount)
- Ask student groups to extend their solution to different levels (20 per cent for more than 300,000 Rs., and 10 per for more than 100,000 Rs., less than 100,000 Rs., no discount)
- Ask student groups to develop a grading systems (A. B, C, and F for marks ranges 75-100, 50-74, 40-49, Less than 40 respectively)
- Ask student groups to write a program add numbers from 1 to 100 using "For" statements
- Ask student groups to write a program to display the first ten triangular numbers
- Ask students to write a program to draw a given triangular number graphically using a "While" loop
- Ask the student groups to write a program to add numbers 1, 2, 3, 4 an so on until the total is less than 50

Guidance for assessments and evaluations:

- o Show a complex program and ask students to identify the structure highlighting Conditional Statements.
- o Provide the output of a program and ask student groups to compare it with the source code and identify that the output is in sequence with the corresponding input commands in case of sequential (non-conditional and non-repetitive) execution
- o Ask student groups to write a program step by step (while executing each structure and observing the output) incorporating all the control structures (Conditions and Repetitions)
- o Given a practical problem, ask the groups to develop a solution using appropriate control structures and write a program

Quality inputs:

- o Computers with python programming language
- o Sample programs
- o Presentations

Competency Level 9.9: Uses sub-programs in programming

Time: 10 periods

Learning Outcomes:

- 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 life time
- 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

Contents:

- Types of subprograms
  - Built in
  - User defined
    - Structure
    - Parameter passing
    - Return values
    - Default values
    - Scope of variables

Concepts and terms to be highlighted:

- Appreciate the fact that a program is composed of logical sub components (programs) connected together
- Appreciate the fact that such components could be pre-programmed and stored in a library for later use by many programs (Built in sub programs)
- Appreciate the fact that in case where there are no built in sub programs to be used as per the programmer's specific need, the programmer can write sub programs (user defined sub programs)
- Appreciate the fact that such user defined sub programs could be stored in a library for later use
- Identify the essential structure and operation of sub programs – inputting data from main program to sub program (parameter passing), and returning the output values from sub program to main program (return values)
- Identify the characteristics of variables that are passed as input and as output (local and global variables, parameter passing by reference (address) and by values)
- Built in and User defined sub programs, Parameter passing, Return values, Default values

Guidance for lesson plans:

- Divide the students into groups
- Provide the groups with sample programs composed few sub programs
- Discuss and introduce a sub program and its' function and behavior
- Ask student groups to identify sub programs in the sample programs
- Describe some built in sub programs in the language being taught

- Question students what they would do if there are no built in sub programs and make students appreciate that such programs can be written by themselves (User defined sub programs)
- Taking a built in sub program as an example, discuss the structure of sub program and how values are being exchanged between the main program and the sub program
- Discuss the nature of global variables and local variables
- Discuss parameter passing by value and by address

Guidance for assessments and evaluations:

- Ask the students to Identify sub programs in the given sample programs
- Ask students to identify which built in sub programs can be used for a given scenario and use them to solve the problem
- Ask students to write a sub program to draw a specific triangular number
- Ask students to write a program to calculate a simple physical quantity (Example: Perimeter of a circle, Area of a square etc.)
- Ask students to make it as a sub program that can be later used in main program (considering parameter passing by reference/ by value, global/ local variable etc.)

Quality inputs:

- Computers with python programming language
- Sample programs
- Presentations

Competency Level 9.10:   Uses data structures in programs

Time: 08 periods

Learning Outcomes:

- Briefly explains the use of data structures
- Uses relevant data structures in programming

Contents:

- Data structures
  o Strings
  o Lists
  o Tuples
  o Dictionaries

Concepts and terms to be highlighted:

- Appreciate the fact that data need to be organized in a certain pattern and order and saved before inputting the data to a program
- Appreciate that different problems need different data structures suitable for the purpose
- Appreciate the characteristics and the method of implementation (array based or otherwise) of the data structures of the language being taught
- Data structures – Strings, Lists, Tuples, Dictionaries

Guidance for lesson plans:

- Explain and demonstrate the data structures Strings, Lists, Tuples, Dictionaries in detail
- Divide the students into groups
- Give a set of data and ask student groups to organize them in a suitable way for inputting to serve a particular purpose (Example: Taking data items one after the other, Taking a pair of data (Example: item name and price) one after the other)
- Ask student groups to write programs using the data defined according to the above mentioned structures

Guidance for assessments and evaluations:

- Ask students to identify the data structures Strings, Lists, Tuples, Dictionaries used in a sample program
- Ask student to write programs to create data structures Strings, Lists, Tuples, Dictionaries to be used in a program
- Ask student groups to write programs using the above mentioned data structures

Quality inputs:

  o Computers with python programming language
  o Sample programs
  o Presentations

Competency Level 9.11: Handles files and databases in programs

Time: 06 periods

Learning Outcomes:

- Uses basic file operations (open, close, read write and append)

Contents:

- File handling
    - o   Basic file operations

Concepts and terms to be highlighted:

- Appreciate the fact that programs need to get data and information from saved files
- Appreciate the fact that such data can be in different as text files
- Appreciate how to refer to a file in a program to get connected to a file
- Appreciate how to open a file, how to read & append data items in it and how to close the file
- Appreciate the situations where file handling is useful in problem solving process
- File handling, basic file operations (open, read/ append and close)

Guidance for lesson plans:

- Discuss how a file can be opened and closed in applications software (Example: Notepad, Word etc.)
- Create a suitable text file and a program for demonstrating file handling operations
- Demonstrate how to create a text file by using a program
- Demonstrate how a file can be accessed via a program in execution
- Divide the students into groups
- Provide some text files and ask the groups to write programs to access them and read and append data
- Ask the groups to write a program for a practical situation

Guidance for assessments and evaluations:

- Ask students to create a sample text file using a Text Editor (Example: Notepad)
- Ask students to open/ read/ close a text file manually and using a program
- Ask students to create a text file and do file handling operations by using a program

Quality inputs:

- o   Computers with python programming language
- o   Sample programs
- o   Presentations

Competency Level 9.12:   Manages data in databases

Time: 04 periods
Learning Outcomes:

- Embeds SQL statements in programming languages to retrieve, add, modify and delete data

Contents:

- Connecting to a database
- Retrieve data
- Add, modify and delete data

Concepts and terms to be highlighted:

- Appreciate the fact that programs need to get data and information from saved database file
- Appreciate how to create a simple database to do database handling operations
- Appreciate how to refer to a database in a program to get connected to a database
- Appreciate how to open a database and how to create a suitable interface program containing forms with validations to retrieve, update, delete and search a database record conveniently
- Appreciate the application of SQL statements to do the above mentioned operations
- Appreciate the simple multiple tables applications of databases to solve practical problems
- Database connectivity, Database handling operations

Guidance for lesson plans:

- Divide the students in to groups
- Ask the groups to create a suitable simple database
- Ask the groups to write a program to get connected to a database
- Ask students to create a program for a given scenario (database) with validations to retrieve, update, delete and search a database record conveniently

Guidance for assessments and evaluations:

- Ask the groups to create a suitable simple database for a given scenario
- Ask the groups to write a program to get connected to the developed database
- Ask students to create a program for a given scenario (database) with validations to retrieve, update, delete and search a database record conveniently

Quality inputs:

  - o Computers with python programming language and database software
  - o Sample programs
  - o Presentations

Competency Level 9.13:   Searches and sorts data

Time: 04 periods

Learning Outcomes:

- Uses sequential searching technique appropriately
- Implements bubble sort technique appropriately

Contents:

- Searching techniques
    - Sequential search
- Sorting techniques
    - Bubble sort

Concepts and terms to be highlighted:

- Appreciate the fact that in real life situations, we have to sort things in order to search and find them fast and easily
- Appreciate the need for sorting data in order to search and find them fast and easily
- Appreciate the concept of searching using Sequential Search techniques in a data set stored in an array
- Appreciate the concept of sorting using Bubble Sort technique
- Appreciate the concept and technique (the need for a dummy variable) of swapping two data items
- Sorting and Searching, Sequential Search, Bubble Sort

Guidance for lesson plans:
- Give numbers randomly to a set of students in the class
- Ask a student to find the student holding a specific number and let the students feel the difficulty in finding the number due to the fact that the numbers are not sorted
- Ask the groups to write a program according to the physical method they were using for searching (Sequential Search)
- Ask students to stand in to a row in an order of the number (ascending or descending) using the Bubble Sort technique starting from the original unsorted set
- Ask the groups to write a program according to the physical method they were using for sorting (Bubble Sort)

Guidance for assessments and evaluations:

- Ask the students to write a program to search a data according to a given situation using Sequential Search
- Ask the students to write a program to sort data according to a given situation using Bubble Sort

Quality inputs:

  - o Computers with python programming language
  - o Sample programs
  - o Presentations

Competency 10: Develops websites incorporating multi-media technologies (using HTML 5)

Competency Level 10.1: Explores the need for web

Time: 08 periods

Learning Outcomes:

- Describes www
- Analyses the systematic arrangements of contents and structure of a web

Contents:

- The world wide web (www)
- Types of web sites
  - Information, news
  - Personal, educational, commercial, Research
  - Web portals

Concepts and terms to be highlighted:

- Appreciate the need for information sharing and communication with others.
- Appreciate the important of computer network in information sharing and communication
- Appreciate the important of the internet and the www in as a global network of computers for information sharing communication.
- Internet
- www
- web portals
- types of web sites

Guidance for lesson plans:

- discuss the need for the web
- discuss computer network as the base for the web
- discuss the www and evolution of www
- divide the student into group
- ask each group to browse the internet search information for given topics the teacher
- Request group to categories the web sites
  - Ex: educational, personal, commercial, etc.

Guidance for assessments and evaluations:

- Ask student to visit website given by the teacher
- Ask student to visit search engine (Google, yahoo, etc.)
- Ask student to search particular topics using to search engine
- Ask them to visit some of the search results (sites)
- Ask student to find the most appropriate site among the search result.
- Ask the student to categories the web site according to given topics (educational, personal, commercial, etc.)

Quality inputs:

- Internet access facility ,Presentations

Competency Level 10.2:   Analyses user requirements (multimedia contents)

Time: 04 periods

Learning Outcomes:

- Creates effective and appropriate information layout of a website
- Identifies the web pages of a website
- Identifies the contents of a web page
- Identifies navigation structure

Contents:

- Defining the objectives of a website
- Contents to be displayed

Concepts and terms to be highlighted:

- To appreciate the need of web site to transmit information effectively
    - Ex: commercial web site is a very useful and effective marketing tool
        - Educational web site as a very useful and effective teaching tool
- To appreciate why it is necessary to identify the target groups of web sites.
    - Ex:- customers of a bank
        - Student in a school
- To identify the most useful and effective information in the web site according to the target groups.

Guidance for lesson plans:

- Divide the student into groups
- Provide web address to each group and ask them to visit those website
- Ask the student to identify the objective of the website
- Discuss the purpose and an objective of each websites
- Ask the groups to observe the website and write the contents displayed
    - Ex: animation, list, headings, pictures, videos, hyperlinks, etc.
- Discuss the content of website and its organization structure

Guidance for assessments and evaluations:

- Divide student into groups
- Provide deferent web address to each group and ask them to visit that website and identify the objective of the web sites and present it.
- Ask the groups to observe the website and identify the structure and contents to displaying and present it.

Quality inputs:

- Internet facility, print out with web address, presentations

Competency Level 10.3:   Identifies appropriate HTML tags to design a single web page

Time: 04 periods

Learning Outcomes:

- Analyses the arrangement of contents of a web page
- Analyses the organization of contents in a web page
- Creates a simple web page

Contents:

- Building blocks of a web page
  - Page definition
  - <html></html>
  - Head section
  - <head></head>
  - <title></title>
  - Body section
  - <body></body>
- Background color
  - Text formatting
  - <h1>…<h6>tags
  - <p></p>
  -
  - Underline, bold, italic
  -
  - Size and color
- Adding comments

Concepts and terms to be highlighted:

- Appreciate that webpages are developed using HTML
- Appreciate that HTML provide various tags to structure the web page
- HTML
- Tags
- Comment
- Attributes
- Elements
- Text editor (notepad, notepad ++)

Guidance for lesson plans:

- Divide the student into group
- Provide teacher developed simple web page to each group and ask the groups to observe the page source and make some miner editing and observe the corresponding out puts.
- Discuss and introduce the building blocks of web page and tags.
  - Page definition
  - Head section
  - Body section

- o Formatting
- o Adding comments etc.
- Ask student groups to construct simple webpage using a text editor. (notepad is recommended)

Guidance for assessments and evaluations:

- Provide the requirements of the web page and ask the student to develop an appropriate simple web page
- Ex:- to develop a simple web page for student profile- name, address, education qualification etc. with his/her photograph

Quality inputs:

- Computers with simple text editors, web browser, presentations

Competency Level 10.4:   Uses HTML to create linked web pages

Time: 16 periods

Learning Outcomes:

- 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

Contents:

- Contents of a website
    - Home page
    - Linked pages
    - Hyperlink
        - ❖ Different sections of the same page(book mark)
        - ❖ Different pages of a same site(local link)
        - ❖ Pages of different sites (External link)
- Lists
    - Ordered lists
    - Unordered lists
    - Definition lists
- Image
- Tables
    - <table></table>
    - <th></th>
    - <tr></tr>
    - <td></td>
    - <caption>
    - Merging columns and rows
- Multimedia objects
    - Audio
    - Video

Concepts and terms to be highlighted:

- To appreciate the structure of a composite website containing several webpages including list, image, table, etc. connected in a logical manner.
- To appreciate the purpose of dividing into several logical pages and why and how there are connected using a hyperlink
- Home page, link page, hyperlink
- List, image, table
- Multimedia objects (audio, video, animation)

Guidance for lesson plans:

- Divide student into group
- Ask the group to visit the suitable website given by the teacher and identify the different component (homepage, link page, list, hyperlink, table, multimedia contents, etc) in the site.
- Discuss and describe each of component and their constructions.
- Discuss the proper save methods with extension (.html, etc)

Guidance for assessments and evaluations:

- Provide the partially completed page source and ask the student to complete appropriately to given web page(filling)
- Provide requirements for a website and ask the students to develop a website accordingly (should include home page, hyperlinks, list, table, multimedia contents)

Quality inputs:

- Computers with simple text editors, web browser, presentations
- Requirement description

Competency Level 10.5:   Uses Style sheet to change the appearance of web pages

Time: 04 periods
Learning Outcomes:

- 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

Contents:

- Introduction to style sheet
- CSS
  - o Syntax, comments
- CSS selectors
  - o element, id, class, group
- Ways of inserting CSS
  - o Internal, external, inline
- Appearance formatting
  - o Background (color, image)
  - o Text and fonts
  - o Links
  - o Lists
- Tables

Concepts and terms to be highlighted:

- Appreciate the importance of appearance of a web page
- Cascade style sheet (CSS)
- Appreciate that CSS is an improvement of HTML

Guidance for lesson plans:

- Divide the student into groups
- Provide teacher developed two web pages, one CSS based and other without CSS.
- Ask the groups to compare the two web pages and their corresponding source codes and present their findings
- Discuss the importance of appearance (attractiveness, user friendliness and creativity) of web page
- Introduce the cascade style sheet
- Discuss and describe the construction of CSS based web pages
- Provide few web pages developed using HTML only and ask student groups to improve them using CSS

Guidance for assessments and evaluations:

- Provide partially done pages using CSS and ask the groups to complete them

- Provide few web pages developed using HTML only and ask student groups to improve them using CSS

Quality inputs:

- Computers with simple text editors, web browser, presentations
- Requirement descriptions

Competency Level 10.6: Uses an authoring tool to create web pages

Time: 10 periods

Learning Outcomes:

- Briefly explains web authoring tools
- Creates web pages using a web authoring tool

Contents:

- Introduction to web authoring tools

Concepts and terms to be highlighted:

- Appreciate that web pages can be generated using web authoring tools (standard development software) without writing html tags
- Appreciate that web pages can be further be developed using html tags
- Web authoring tools
    - Ex: - Dream weaver, Composer, etc.

Guidance for lesson plans:

- Divide the students into groups
- Demonstrate how to generate web pages using a suitable web authoring tool
- Demonstrate that generated web pages can be edited by manually with HTML viewer/editor of that tool
- Ask the student groups to develop web site using authoring tool
- Ask student groups to edit the generated web site and make some changes

Guidance for assessments and evaluations:

- Ask the student groups to generate some web pages using a web authoring tool specified by the teacher (If Internet access is available, the teacher may guide the students to use an online tool)
- Ask the student groups to further develop them using html tags
- Ask the student groups to further develop them using CSS
- Ask the student groups to link the pages appropriately and make a comprehensive web site

Quality inputs:

- Computers with Web authoring tool, web browser
    - presentations
    - Requirement descriptions
    - Internet facilities

Competency Level 10.7:   Creates dynamic web pages using PHP and MySQL

Time: 06 periods

Learning Outcomes:

- Defines dynamic web pages
- Creates data source and enters data
- Creates PHP code to save/retrieve data to and from MySQL
- Develop simple web based information systems

Contents:

- Introduction to dynamic web pages
- Embedding PHP code into web page
    - Variables
    - Arrays
    - Control structures
    - Functions
    - Database connectivity
    - Working with databases
- Forms
    - Input element
        - ❖ Type attribute
        - ❖ Name attribute
        - ❖ Value attribute
    - Text input (Password)
    - Radio buttons
    - Check box
    - Selection
    - Submit buttons
    - Reset button
    - Action attribute
    - Method attribute
        - ❖ Get
        - ❖ Post
    - Grouping form data using <field set> 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

Concepts and terms to be highlighted:

- Characteristics of a dynamic web page
- Difference between the server based scripting and desktop applications
- Need for the use of a server side scripting language to access a database
- Embedding PHP code into a web page
- Concept of web based information systems
- Appreciate how data source (MySQL) is accessed using a server side scripting language (PHP) via a web page

- Web browser
- Scripting language (Example: PHP)
- Server (Example: Apache)
- Database software (Example: MySQL)
- WAMP, XWAMP

Guidance for lesson plans:

- Divide the students into groups
- Demonstrate few static web pages and dynamic web pages
- Ask students to identify the features of static web pages and dynamic web pages (Example: data source available in dynamic etc.)
- Introduce PHP (commands, syntax etc.)
- Demonstrate how to create a data source (MySQL) and populate the database with some data using MySQL commands
- Demonstrate how to embed an appropriate PHP code in to the source web page to retrieve data from the MySQL database
- Demonstrate how to embed an appropriate PHP code in the source web page to enter and save data in the MySQL database and view the data
- Ask student groups to develop a simple web based information system

Guidance for assessments and evaluations:

- Create a data source (MySQL) and populate the database with some data using MySQL commands
- Create a web page and embed an appropriate PHP code into it to retrieve data from the MySQL database
- Embed an appropriate PHP code in the source web page to enter and save data in the SQL database and view the data
- Demonstrate the system to the class

Quality inputs:

- Computers with Server software (ex:- XAMP/WAMP/LAMP)
- Internet and Internet resources (ex:- YouTube)
- A list of required PHP and MySQL commands
- Presentations

Competency Level 10.8:   Publishes and maintains web sites

Time: 04 periods

Learning Outcomes:

- 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

Contents:

- Local publishing
    - Own computer, intranet
- Internet publishing
    - Connecting to the web Service provider
    - Publishing web Pages on web server
- Factors affecting performance of website

Concepts and terms to be highlighted:

- Appreciate the need of publishing of developed website, locally and globally
- Identify the requirements of local publishing
    - Conform to the specification
    - Conform to the quality - testing the interface and appearance, authentications, web browser compatibility, etc.
- Identify the procedures of Internet publishing
    - Ex: The need of ISPs and Protocols etc.
- Appreciate different ways of web hosting
    - Ex : free & paid, and shared & dedicated web hosting
- Identify few web hosting sites
- Appreciate the need for maintaining and upgrading the website for uninterrupted browsing and keeping the information up to date
- Identify the factors affecting (upload/download speeds etc. as well as usability, navigation, concurrent use etc.) the performance of the web site
- Appreciate the need of search engines making DNS servers updated (SEO - Search Engine Optimization) with the new websites
- Appreciate the need for protecting the website against hackers

Guidance for lesson plans:

- Visiting some websites and discuss the concept of publishing (locally and globally, separately) so that other people can visit the site and read the content
- Divide the students into groups
- Ask student groups to host the website they developed in the local server (or desktop) and check against the specification whether the requirements and quality is achieved, and present their experience
- Discuss that the local publishing is necessary as a test before global publishing

- Ask the student groups to find the procedures (creating a unique name, uploading the website etc.) of global publishing through and Internet search, and discuss.
- Ask student groups to find some web hosting sites (both free and paid) through an Internet search
- Ask student groups to host their web site in a free hosting site following the procedures they discovered
- Discuss the need for maintaining and upgrading the website for uninterrupted browsing and keeping the information up to date
- Discuss and ask the student groups to identify the factors affecting (upload/download speeds etc. as well as usability, navigation, concurrent use etc.) the performance of the web site
- Discuss the need and the procedures of updating DNS using web crawler
- Discuss the need and the procedures of Search Engine Optimization (SEO)
- Discuss the need for protecting the website against hackers and ask the students to find some interesting cases using an Internet search
- Discuss how access is controlled using passwords and the content is protected using encryption techniques (Briefly mention about http and https and demonstrate few websites using https – bank transactions, credit card transactions etc.)

Guidance for assessments and evaluations:

- Divide the students into groups
- Ask the groups to host their developed web site in a free hosting site following the procedures they studied

Quality inputs:

- Internet facility, Presentations, LAN facility, Software for file uploading(ex: filezilla)

Competency 11: Explores IoT and identify the building blocks of embedded systems to develop simple applications

Competency Level 11.1: Acquires the knowledge of basic building blocks of embedded systems

Time: 08 periods

Learning Outcomes:

● Identifies and lists microcontroller based development boards
● Describes available features on a microcontroller based development board
● Identifies necessary software and download them from the Internet to develop a microcontroller based embedded system
● Develops simple applications using a microcontroller based development board
   – Switch a LED on/off on ambient light intensity
   – Run a fan on room temperature
   – Detect door opening /closing using a read switch

Contents:

○ Microcontroller - Based Development Systems (Arduino and other similar systems)
○ Introduction
   ❖ Embedded systems
   ❖ Microcontroller based embedded systems vs. microprocessor based embedded systems
○ Features
   ❖ Analog Input
   ❖ Digital Input
   ❖ Microcontroller
   ❖ Digital Output
   ❖ Data Receiver and Transmitter
   ❖ Communication Port
   ❖ Power supply
○ Connect to the computer
   ❖ USB Connectivity
   ❖ IDE Software (code editor, compiler and programmer)
○ Simple applications
   ❖ Switching a LED on/off
   ❖ Sensing ambient light intensity with a LDR and switching a LED on and off depending on the light intensity
   ❖ Sensing the room temperature with a temperature sensor and switching a fan on and off depending on the temperature
   ❖ Detection of opening/closing a door using a read switch

Concepts and terms to be highlighted:

- Embedded system - typically a microcontroller based system embedded into an external electro-mechanical system (known as Physical Computing)
- Microcontroller based embedded systems vs. microprocessor based embedded systems
- Microcontroller - a single chip with CPU, memory, input/output ports, and other hardware components (Timers, Counters, Oscillators, Analog - Digital Converter etc.)
- Embedded system
- Microcontroller
- Physical Computing
- Features (Analog Input, Digital Input, Digital Output, Data Receiver and Transmitter, Communication Port, Power supply, Reset switch)

Guidance for lesson plans:

- Discuss the similarities and differences between a general purpose computer and an embedded system (compare a general purpose computer with digital camera, mobile phone, a computerized car etc.)
- Divide the students into groups
- Provide a microcontroller based development board to each student group and ask to identify features in the development board
- Describe the purpose and the functionality of each feature
- Demonstrate a sample embedded system and its functionality
- Discuss and identify a suitable physical system for which an embedded system can be developed
- Ask the student groups to identify the required components for the proposed embedded system
- Guide the student groups to draw a schematic diagram for the proposed embedded system
- Guide the student groups to assemble the components of the proposed embedded system according to the schematic diagram
- Discuss the need to develop a software for controlling the embedded system assembled using an Integrated Development Environment (IDE)
- Demonstrate how to use a Code Editor, Compiler and Programmer integrated into an IDE
- Guide the student groups to design the software to be programmed into the microcontroller starting from a flowchart
- Introduce the syntax of the selected programming language for the purpose
- Guide the student groups to transform the flowchart into a source code using the IDE
- Guide the student groups to compile the source code and program the machine code into the microcontroller using the IDE
- Guide the student groups to connect the embedded system to a power supply and observe the intended behavior of the system (observe the outputs for specific inputs and verify that the required functionality is delivered)
- Ask the student groups to design, code and implement the following embedded systems:
    - Switch a LED on and off

- o Sensing ambient light intensity with a LDR and switching a LED on and off depending on the light intensity
- o Sensing the room temperature with temperature sensor and switching a fan on and off depending on the temperature
- o Detection of opening/closing a door using a read switch

Guidance for assessments and evaluations:

- Provide a scenario to the student groups to develop an embedded system
- Ask student groups to develop the embedded system according to the steps that they have learnt
- Organize an exhibition of embedded systems developed in the class
- Ask student groups to demonstrate the embedded systems developed

Quality inputs:

- Open source electronic platform - Microcontroller based development boards (Arduino, Micro:bit, Raspberry pi)
- Input/output components (Example: LDR for input, LED for output)
- Computers with python software (Integrated Development Environment - IDE)
- Internet connection
- Presentations

Competency Level 11.2: Explores the Internet of Things (IoT) to create a simple application

Time: 07 periods

Learning Outcomes:

- Defines IoT (Internet of Thing)
- Identifies the needs of IoT to make day to day life smart
- Discusses the various applications of IoT
- Identifies the enabling technologies for IoT
- Designs and implements an IoT application to remotely control a device over Internet
  Example: switching a LED on and off over the Internet
- Uses IoT based systems while knowing the social and security consequences of IoT

Contents:

- Introduction to IoT
  - Definition
  - Needs
  - IoT applications
  - Enabling technologies
- Simple IoT application to remotely control a device over the Internet

Concepts and terms to be highlighted:

- Appreciate the concept of "Smart World" comprising of IoTs where life is full of autonomous interconnected smart systems
- IoT - a network of interoperated embedded system communicating with each other over the Internet
- Appreciate the need for IoT in modern world where things communicate and interoperate with other things over the internet (Example: a smart refrigerator orders the items over the Internet from a supermarket automatically when items go below their re-order level)
- Appreciate how convenient and comfortable life is with IoT (Example: if there is nothing available in the refrigerator for dinner, have a pizza delivery to home automatically when you return home)
- Appreciate the fact that IoT can be applied to any physical system (Example: smart homes, smart cities, smart transport, smart health etc.)
- Appreciate the increasing availability of miniature electronic components, communication lines with higher bandwidth and speed (Example: nano technology, sensor technology, network technology etc.)
- Identify the basic components of an IoT device, namely input devices (Example: sensors), communication channel (Example: Internet), processing unit (Example: Microcontroller), and output devices (Example: actuators)
- Sensor - component that identifies inputs (detects a state change in environment)
- Communication channel - a media that is used to establish a communication link between interoperating devices/systems

- Processing unit - component that makes decisions according to the inputs and some predetermined rules and then drives actuators
- Actuator - component that produces outputs (changes the state of environment)
- Social and security consequences of IoT

Guidance for lesson plans:

- Discuss the concept of smart world using some interesting examples
- Discuss the benefits (convenience, efficiency etc.) of smart systems
- Divide the students into groups and ask each group to find a smart system by searching on Internet and present it to the class
- Ask the student groups to analyze the smart systems they presented, and identify inputs, processing rule and corresponding outputs
- Discuss the technologies used in IoT systems, and ask the student groups to identify the particular technologies in the smart system that they found
- Provide a simple IoT application to design and implement a smart system (Example: switching a LED on and off over the Internet)
- Discuss social and security consequences of IoT (social isolation, unauthorized access/control of IoT devices, privacy issues)

Guidance for assessments and evaluations:

- Provide a scenario to student groups to develop an IoT application
- Ask student groups to develop the IoT application according to the steps they have learnt
- Organize an exhibition of IoT applications developed in the class
- Ask each student group to exhibit their IoT applications and demonstrate them

Quality inputs:

- Open source electronic platform - Microcontroller based development boards (Arduino, Micro:bit, Raspberry pi)
- Input/output components (Example: web browser for input, LED for output)
- Computers with python software (Integrated Development Environment - IDE)
- Internet connection
- Presentations

Competency 12:   Explores applicability of ICT to business organizations and the competitive marketplace

Competency Level 12.1:   Explores the role of ICT in the world of business

Time: 04 periods

Learning Outcomes:

- 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

Contents:

- Digital economy
  - New business methods in digital economy
    - ❖ Reverse auctions
    - ❖ Group purchasing
    - ❖ e-Marketplace
- Pure brick, brick and click, and pure click organizations
- Business functions and the role of ICT
  - 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
    - ❖ Payment gateways
    - ❖ Secure credit card payments
    - ❖ Third party systems
      - – PayPal etc
    - ❖ Mechanisms
      - – Data encryption
      - – Virtual and crypto currencies (bit coin etc.)
- Threats and opportunities of ICT in business
  - Privacy
  - Security
  - Product commercialization

Concepts and terms to be highlighted:

- Appreciate the contribution of ICT in the world of business to improve the economy of the country

- Identify the new business methods in digital economy
- Identify the functions and the role of ICT in business
- Identify the opportunities and threats of ICT in business
- Digital Economy
- Reverse auction, group purchasing, e-marketing
- Types of business organizations in Digital Economy (Pure bricks, brick and click, pure click)
- Security, Privacy, product commercialization

Guidance for lesson plans:
- Discuss the business and its contribution to economy
- Divide the student into groups , provide both online and offline business scenarios and ask the student groups to compare and contrast them
- Ask student groups to present their findings
- Discuss and introduce computer-based solutions to traditional business processes
- Discuss how ICT contributes and improves the economy of a country with suitable examples
- Discuss with examples the different types of business organizations in digital economy
- Ask student groups to identify business functions supported by ICT by searching on the Internet or using other means (mobile payments, mobile banking, ATM, ticket reservation, doctor channeling etc.)
- Discuss and evaluate the possible secure payment mechanisms (credit cards, debit cards, pay pal, etc.)
- Ask student groups to evaluate the opportunities and threats of e-commerce and present their finding
- Discuss the findings of the student groups presented

Guidance for assessments and evaluations:
- Ask students to summarize all their presentation findings into a written report and submit as an assignment

Quality inputs:
- Internet facility, Presentations, Video clips

Competency Level 12.2   Analyses the relationship between ICT and business operations

Number of Periods: 04

Learning Outcomes:

- Distinguishes the e-commerce and e-business
- Investigates the scope of e -commerce and e- business
- Lists and briefly describes the types of e- commerce transactions
- Identifies the advantages and disadvantages of e- commerce

Contents:

- E-Commerce and e-business
  - The scopes of e-commerce and e-business
  - Types of e-commerce transactions
    - ❖ B2B, B2C, C2C, C2B, B2E, G2C
- Internet and Business
  - Virtual storefronts
  - Information brokers
  - Online marketplace
  - Content provider
  - Online service provider
  - Portal
  - Virtual Community
    Advantages and disadvantages of e-business
- E-commerce trends (becoming more social, mobile-based, etc

Concepts and terms to be highlighted:

- Compare and contrast of e-commerce and e-commerce and their scope
- Identify the types of e-business transactions (B2B, B2C, C2C, C2B, B2E, G2C)
- Appreciate the contributions of e-commerce to the economy of a country while recognizing the disadvantages of e-commerce
- Discuss the recent e-commerce trends
- e-business, e-commerce

Guidance for lesson plans:

- Divide the student into groups , provide both e-commerce and e-business scenarios and ask the student groups to compare and contrast them
- Ask student groups to present their findings
- Discuss the deference between e-commerce and e-business and their scope with the findings of the student groups presented
- Discuss and introduce the types of e-commerce transactions with examples
- Ask student groups to evaluate the advantages and disadvantages of e-business and present their findings

- Discuss the recent trends in e-commerce with statistics and examples

Guidance for assessments and evaluations:

- Ask students to summarize all their presentation findings into a written report and submit as an assignment

.**Quality inputs:**
- Internet facility, Presentations, video clips

Competency Level 12.3   Analyses the ICT in terms of generating and delivering an improved products and services to consumers

Number of Periods: 04

Learning Outcomes:

- Defines e- marketing
- Identifies the role of ICT in e-marketing
- Investigates the usage of databases in marketing activities to improve the product and services according to the requirements of the customers
- Identifies the ways of gaining competitive advantages using ICT

Contents:

- E-marketing
  - Concepts of marketing
  - Use of ICT in marketing
    - ❖   Web advertising, data mining etc
- Databases in marketing
  - Predicting customer behavior with data mining tools and techniques
  - Gaining competitive advantages through ICT
- Mobile Marketing

Concepts and terms to be highlighted:

- Appreciate the contribution of ICT in the marketing to efficiently provide the goods and services to the consumer
- Concept of e-marketing
- Identify use of ICT in marketing
- Identify the contributions of electronic databases in marketing
- Identify the benefits and issues of mobile marketing

Guidance for lesson plans:

- Discuss the concepts of marketing
- Divide student into groups
- Ask student groups to a identify the contributions of ICT in marketing and present their findings
- Discuss the findings of the student groups presented
- Ask student groups to investigates the contributions of electronic databases in marketing by searching on the Internet and present their findings
- Discuss the findings of the student groups presented
- Discuss and describe the concept of mobile marketing
- Ask student groups to identify the contributions of mobile marketing and present their findings
- Discuss the findings of the student groups presented

Guidance for assessments and evaluations:

- Ask students to summarize all their presentation findings into a written report and submit as an assignment
.

Quality inputs:
- Internet facility, Presentations, Video clips

Competency 13: Explores new trends and future directions of ICT

Competency Level 13.1   Explores new trends and future directions in computing

Number of Periods: 04

Learning Outcomes:

- Describes intelligent and emotional computing.
- Explains artificial intelligences
- Appreciates man- machine coexistences

Contents:

- Intelligent and emotional computing
- Artificial intelligence
- Man-machine coexistence
- Machine to machine coexistence

Concepts and terms to be highlighted:

- Appreciate that intelligence can be created artificially for day to day activities
- Appreciate interacting applications using Artificial intelligence need Man-machine and Machine to machine coexistences
- Intelligent and emotional computing, Artificial intelligence, Man-machine coexistence, Machine to machine coexistence

Guidance for lesson plans:

- Discuss and describe concept of intelligent and emotional computing
- Demonstrate an example of the usage of Artificial Intelligence by showing a video clip
- Divide student into groups and ask the student groups to identify some usage of artificial intelligent by searching on Internet
- Discuss and describe the man-machine coexistence and machine to machine coexistence
- Demonstrate some man-machine coexistence and machine to machine coexistence by using a video clip

Guidance for assessments and evaluations:

- Divide the student into groups
- Ask student groups to prepare presentation on artificial intelligent and present to the class
.
Quality inputs:
- Internet facility, Presentations, video clips

Competency Level 13.2   Explores the fundamentals and applications of agent technology

Number of Periods: 04

Learning Outcomes:

- Briefly describes software agents and their characteristics
- Briefly describes multi-agent systems and their characteristics
- Identifies the applications of agent systems

Contents:

- Software agents
- Multi-agent systems
- Applications of Agent systems

Concepts and terms to be highlighted:

- Software agent – is a software which act as an agent for users or another program work in autonomously and continuously in a particular environment
- Multi-agent systems – a computerized system composed with multiple interacting agent systems in a particular environment

Guidance for lesson plans:

- Discuss and describe the concept of software agent and multi-agent systems
- Demonstrate an examples of software agent and multi-agent systems by showing a video clip
- Divide student into groups and ask the student groups to identify some applications of Agent Systems and present
- Discuss the findings of the student groups presented

Guidance for assessments and evaluations:

- Divide the student into groups
- Ask student groups to prepare presentation on software agents and applications of Agent systems and present to the class

Quality inputs:
- Internet facility, Presentations, video clips

Competency Level 13.3   Analyzes the existing models of computing and proposes new models

Number of Periods: 04

Learning Outcomes:

- Predicts the technologies beyond von-Neumann computers

Contents:

- Beyond von-Neumann computer
- Nature inspired computing
- Bio inspired computing
- Fundamentals of quantum computing
- Applications

 Concepts and terms to be highlighted:

- Nature inspired computing
- Bio inspired computing
- Quantum computing Applications

Guidance for lesson plans:

- Discuss and describe the concept of beyond von-Neumann computers, Nature inspired computing, Bio inspired computing, Fundamentals of quantum computing
- Divide the students into groups and assign each of above concept to groups and ask them to search about them and their applications by Internet and present to the class
- Discuss the findings of the student groups presented

Guidance for assessments and evaluations:

- Ask students to summarize all their presentation findings into a written report and submit as an assignment

Quality inputs:
- Internet facility, Presentations, video clips

Competency 14:   Designs and Implements a simple Information system project

Competency Level 14.1:   Conducts a project on designing an information system

Competency Level 14.2:   Implements and demonstrates the Information system

Time: 30 periods

Learning Outcomes:

- Identifies the characteristics and reasons of projects with examples
- Identifies the role of stakeholders
- Identifies the reasons of project plan and the planning criteria
- Identifies a simple problem to be carryout as a project
- Prepares project proposal
- Presents the proposal
- Organizes the project
- Carries out the project according to the SDLC phases
- Hands over the outcomes of each phase to documentation after an evaluation by the teacher
- Presents the finished project and demonstrates the system to all the class

Contents:

- Examples of projects
- Stakeholders
    - Roles and responsibilities of the following stakeholders:
        - Senior management
        - Customer/client
        - User
        - Project manager
        - Team member
        - peer reviewer
        - Supplier
- Project planning
    - The phases of the project
    - The activities to be carried out in each phase
    - Start date and end date of each activity
    - Dependencies
    - Resources required for each activity
    - Dates of key milestones
    - Potential risks, their effect on the plan and how their impact can be minimized
    - Gantt charts
- Identification of a simple problem for the project
- Project proposal
    - Proposal preparation
    - Getting approval
- Project organization
    - Storing documents relating to a project (project folder)

o Protecting information from accidental damage
o Communicating with stakeholders
o Reporting on progress
o Holding reviews

Phases of a project

o Preliminary investigation
o Feasibility study
o Requirement analysis
o Design
o Coding
o testing
o Documentation

Project presentation and demonstration of the system

Concepts and terms to be highlighted:

- Appreciate the nature and the purpose of a project
- Identify the stakeholders (customers, developer, manager etc.) and their roles
- Appreciate the fact that a project needs to be planned from project identification phase through the implementation phase
- Appreciate the fact that a problem needs to be identified, a feasibility study done and a proposal made before the system design and development
- Appreciate the importance and the purpose of each phase of project management
- Experiencing a project: Problem Identification, Feasibility study, Requirement Gathering & Requirement Analysis, System Design, System Development, Testing and Quality Assurance, Implementation (Demonstration)
- Problem Identification, Feasibility study, Requirement Gathering & Requirement Analysis, System Design, System Development, Testing and Quality Assurance, Implementation

Guidance for lesson plans:

- Discuss the nature and the purpose of a project (1 Period)
- Discuss the role of the stakeholders (customers, developer, manager etc.) and the need for collective efforts of each stakeholder to make a project successful (2 Periods)
- Describe and discuss the stages of a project: Problem Identification, Feasibility study, Requirement Gathering & Requirement Analysis, System Design, System Development, Testing and Quality Assurance, Implementation (Demonstration) (2 Periods)
- Guide students to how to find an appropriate project title by discussing their own examples and selecting an appropriate one form them
- Ask students to do the project for the selected topic following each of the following steps: Problem Identification, Feasibility study, Requirement Gathering & Requirement Analysis, System Design, System Development, Testing and Quality Assurance, Implementation
- Introduce project proposal formats and report formats
- A Proposal : Title, Problem Statement, Feasibility Study (Potential Solutions and the Best Solution), Solution Details
- Report: Title, Abstract of the Solution, System Overview and Analysis, System Design, Description of the System Components with Brief Code Segments, Test Data and Corresponding Output
- Ask students to make a presentation slides and a brief report (4 – 6 pages) on the project

- Ask students to present the project

Guidance for assessments and evaluations:

- Ask students to bring some project ideas, and ask them to find a suitable appropriate project title
- Ask student to submit a proposal and briefly present them to the class and a panel (ICT teacher in cooperation with 1 -2 other appropriate school teachers, if possible)
- Ask students to do the project for the selected topic following each of the following steps: Problem Identification, Feasibility study, Requirement Gathering & Requirement Analysis, System Design, System Development, Testing and Quality Assurance, Implementation
- Ask students to make a presentation slides to the class and a panel (ICT teacher in cooperation with 1 -2 other appropriate school teachers, if possible)
- Ask students to submit and a brief report on the project (4 – 6 pages)

Quality inputs:

- Computers with programming language and database software
- Multimedia Projector
- Appropriate software
- Sample Projects, Project Proposals, Project Reports, Presentation Slides
- Presentation

English-Sinhala-Tamil Glossary

No	English	Sinhala	Tamil
1.	abstract model	වියුක්ත ආකෘතිය	கருத்தியல் மாதிரி
2.	acceptance testing	ප්‍රතිග්‍රහණ පරීක්ෂාව	ஏற்புச் சோதனை
3.	access privilege	ප්‍රවේශවීමේ වරප්‍රසාදය	அணுகல் உரிமை
4.	agile model	සුචලඃ ආකෘතිය	சுறுசுறுப்பு மாதிரி
5.	alternate key	විකල්ප යතුර	மாற்றுச் சாவி
6.	American Standard Code for Information Interchange (ASCII)	තොරතුරු හුවමාරුව සඳහා වූ ඇමරිකානු සම්මත කේතය	தகவல் இடைமாற்றுக்கான அமெரிக்க நியம விதிக்கோவை
7.	amplitude	විස්තාරය	வீச்சம்
8.	amplitude modulation	විස්තාර මූර්ජනාව	வீச்சப் பண்பேற்றம்
9.	analog	ප්‍රතිසම	ஒப்புமை
10.	anchor	රැඳවුම	நிலை நிறுத்தி
11.	application layer	අනුප්‍රයෝග ස්ථරය	பிரயோக அடுக்கு
12.	architecture	නිර්මිතය	கட்டமைப்பு
13.	arithmetic and logical unit (ALU)	අංක ගණිත හා තාර්කික ඒකකය	எண்கணித மற்றும் தர்க்க அலகு
14.	array	අරාව	அணி
15.	artificial intelligence	කෘතිම බුද්ධිය	செயற்கை நுண்ணறிவு
16.	Affective computing	බුද්ධිමත් සහ චිත්තවේගී පරිගණනය	நுண்ணறிவு உணர்திறன்மிக்க கணித்தல்
17.	associative law	සංඝටන න්‍යාය	கூட்டு விதி
18.	attenuation	වැහැරීම/භායනය	நொய்மை
19.	attribute	උපලැකිය /ගුණය/ උපලක්ෂණය	பண்புகள்
20.	authoring tool	සම්පාදන මෙවලම	படைப்பாக்கக் கருவி

21.	Automated Teller Machine (ATM)	ස්වයංක්‍රිත මුදල් ගනුදෙනු යන්ත්‍රය	தானியங்கிப் பணம் கையாள் இயந்திரம்
22.	autonomous	ස්වයංපාලක/ ස්වතන්ත්‍ර/ස්වායත්ත	சுயாதீன
23.	axiom	ස්වසිද්ධිය/ප්‍රත්‍යක්ෂය	வெளிப்படை உண்மை
24.	backups	උපස්ථ	காப்பெடுத்தல்
25.	bandwidth	කලාප පළල/බඳස් පළල	பட்டை அகலம்
26.	batch processing	කාණ්ඩ සැකසුම	தொகுதி முறைவழியாக்கம்
27.	big data	මහා දත්ත	பெரிய தரவு
28.	binary	ද්විමය	துவிதம், இருமம்
29.	binary coded decimal (BCD)	ද්විමය කේතික දශමය	இருமக் குறிமுறை தசமம்
30.	bio-inspired computing	ජෛව ප්‍රේරිත පරිගණනය/ ජෛව අනුප්‍රේරිත පරිගණනය	உயிரியல் உள்ளீர்ப்புக் கணிப்பு
31.	bit coin	බිටු කාසි	நுண்கடன் பணம் செலுத்தல்
32.	bitwise	බිටු අනුසාරිත	பிட் வாரி
33.	bitwise logical operation	බිටු අනුසාරිත තාර්කික මෙහෙයුම්	பிட் வாரி தர்க்கச் செயற்பாடு
34.	black box testing	කාල මංජුසා පරීක්ෂාව	கறுப்புப்பெட்டிச் சோதிப்பு
35.	blogging	වෙබ් සටහනය	வலைப்பதிவிடல்
36.	boot–up	ප්‍රවේශනය	தொடங்குதல்
37.	broadcasting	විකාශනය	தொலைபரப்பல்
38.	browsing	අතරික්සීම	மேலோடல்
39.	bubble sort	බුබුළු තේරීම/ යා-සැසඳුම් තේරීම	குமிழி வகைப்படுத்தல்
40.	built-in	තුළබැඳි / තිළැලි	உட்பொதிந்த
41.	business process re-engineering (BPR)	ව්‍යාපාර ක්‍රියාවලියේ ප්‍රති ඉංජිනේරුකරණය	வணிக செயல்முறை மீள்கட்டமைப்பு

42.	candidate key	නිරූපක යතුර	பிரதிநிதித்துவச் சாவி
43.	cardinality	ගණනීයතාව	எண்ணளவை
44.	cathode ray tube (CRT)	කැතෝඩ කිරණ නලය	கதோட்டுக் கதிர் குழாய்
45.	central processing unit)CPU)	මධ්‍ය සැකසුම් ඒකකය	மத்திய செயற்பாட்டு அலகு
46.	characteristics	ගති ලක්ෂණ / ස්වලක්ෂණ	சிறப்பியல்புகள்
47.	check box	සලකුණු කොටුව	சரிபார்ப்புப் பெட்டி
48.	client-server model	සේවා යෝජක-සේවා දායක ආකෘතිය	சேவைப் பயனர் மாதிரி
49.	clock	ස්පන්දකය	கடிகாரம்
50.	cloud computing	වලාකුළු පරිගණනය	மேகக் கணிமை
51.	coaxial cable	සමක්ෂක කේබලය	ஓரச்சு வடம்
52.	code editor	කේත සංස්කාරක	குறிமுறை தொகுப்பி
53.	comment	විවරණය	விளக்கக் குறிப்பு
54.	commutative law	න්‍යායදේශ න්‍යාය	பரிமாற்று விதி
55.	compact disc	සුසංහිත ඩිස්කය	ஒளியியல் வட்டு
56.	compatibility	ගැළපුම	பொருந்துகை
57.	compiler	සම්පාදකය	தொகுப்பான்
58.	component	සංරචකය	கூறு
59.	composite key	සංයුක්ත යතුර	கூட்டுச் சாவி
60.	constant	නියතය	மாறிலி
61.	content management system (CMS)	අන්තර්ගත කළමනාකරණ පද්ධතිය	உள்ளடக்க முகாமைத்துவ முறைமை
62.	context switching	සන්දර්භ සුවිචනය	சந்தர்ப்ப நிலைமாற்றல்
63.	contiguous allocation	යාබද විභාජනය	அடுத்தடுத்தான ஒதுக்கீடு
64.	control structure	පාලන ව්‍යුහය	கட்டுப்பாட்டுக் கட்டமைப்பு

65.	control unit (CU)	පාලන ඒකකය	கட்டுப்பாட்டலகு
66.	credit card	ණයපත	கடனட்டை
67.	customization	අභිරුචිකරණය	தனிப்பயனாக்கல்
68.	data	දත්ත	தரவு
69.	data and control bus	දත්ත සහ පාලන පථ	தரவும் கட்டுப்பாட்டுப் பாட்டையும்
70.	database management system)DBMS)	දත්ත සමුදාය කළමනාකරණ පද්ධති	தரவுத்தள முகாமைத்துவ முறைமை
71.	data definition language (DDL)	දත්ත නිර්වචන භාෂාව	தரவு வரையறை மொழி
72.	data dictionary	දත්ත ශබ්දකෝෂය	தரவு அகராதி
73.	data flow diagram	දත්ත ගැලීම් සටහන	தரவு பாய்ச்சல் வரைபடம்
74.	data flow model (DFM)	දත්ත ගැලීම් ආකෘතිය	தரவு பாய்ச்சல் மாதிரி
75.	data link layer	දත්ත සබැඳි ස්ථරය	தரவு இணைப்பு அடுக்கு
76.	data manipulating language (DML)	දත්ත හැසුරුම් බස	தரவு கையாளல் மொழி
77.	data migration	දත්ත පරියටනය	தரவு பெயர்ச்சி
78.	debugging	නිදොස් කිරීම	வழு நீக்கல்
79.	decision support system (DSS)	තීරණ සහාය පද්ධති	தீர்மான உதவு முறைமை
80.	declarative	ප්‍රකාශාත්මක	அறிவிப்பு
81.	default values	පෙරනිම් අගය	இயல்புநிலை மதிப்பு
82.	defragmentation	ප්‍රතිබණ්ඩනය	துணிக்கை நீக்கல்
83.	demodulation	විමූර්ජනය	பண்பிறக்கம்
84.	device	උපාංගය / උපකුමය	சாதனம்
85.	device driver	උපාංග ධාවක මෘදුකාංග	சாதனச் செலுத்தி
86.	digital	අංකිත	இலக்க முறை

87.	digital camera	අංකිත කැමරාව	இலக்கமுறைப் படக்கருவி
88.	digital economy	අංකිත ආර්ථිකය	இலக்கமுறைப் பொருளாதாரம்
89.	digitizer	සංඛ්‍යාංකකය	இலக்கமாக்கி
90.	direct implementation	සෘජුස්ථාපනය	நேரடி அமுலாக்கம்
91.	disk formatting	තැටි/ඩිසක හැඩසව් ගැන්වීම	வட்டு வடிவமைப்பு
92.	distortion	විකෘතිය	திரிபு
93.	distributive law	විසටන න්‍යාය	பங்கீட்டு விதி
94.	document flow diagram	ලේඛන ගැලීම් සටහන	ஆவணப் பாய்ச்சல் வரைபடம்
95.	domain	වසම	ஆள்களம்
96.	domain name server (DNS)	වසම් නාම සේවාදායකය	ஆள்களப் பெயர் சேவையகம்
97.	domain name system (DNS)	වසම් නාම පද්ධතිය	ஆள்களப் பெயர் முறைமை
98.	dynamic host configuration protocol (DHCP)	ගතික ධාරක පාලන නියමාවලිය	மாறும் விருந்தோம்பி உள்ளமைவு நெறிமுறை
99.	dynamic web page	ගතික වෙබ් පිටු	இயக்குநிலை வலைப்பக்கம்
100.	e-commerce	විද්‍යුත් වාණිජ්‍යය	மின் வர்த்தகம்
101.	economical feasibility	ආර්ථික ශක්‍යතාව	பொருளாதாரச் சாத்தியப்பாடு
102.	elementary process description)EPD)	මූලික ක්‍රියාවලි විස්තරය	அடிப்படைச் செய்முறை விபரிப்பு
103.	e-market place	ඉ-වෙළඳ පොළ	இலத்திரனியல் சந்தை இடம்
104.	encryption	ගුප්ත කේතනය	மறைகுறியாக்கம்
105.	enterprise resource planning system (ERPS)	ව්‍යවසාය සම්පත් සැලසුම් පද්ධතිය	நிறுவன மூலவள திட்டமிடல் முறைமை

106.	entity	භූතාර්ථය/අභිභූතත්වය/සත්තාව	நிலைபொருள்
107.	entity identifier	භූතාර්ථ/අභිභූතත්වය හඳුන්වනය	நிலைபொருள் அடையாளங்காட்டி
108.	entity relationship(ER) diagram	භූතාර්ථ සම්බන්ධතා රූපසටහන	நிலைபொருள் உறவுமுறை அட்டவணை
109.	executable	ක්‍රියාත්මක කළ හැකි	இயக்கத்தகு
110.	executive support system (ESS)	විධායක සහාය පද්ධතිය	நிறைவேற்று உதவு முறைமை
111.	expert system	විශේෂඥ පද්ධතිය	நிபுணத்துவ முறைமை
112.	extended binary coded decimal interchange cod (EBCDIC)	විස්තෘත ද්වීමය කේතක දශම	நீடித்த துவித குறிமுறை தசம இடமாற்றக் குறி
113.	extended entity relationship (ER) diagram	විස්තෘත භූතාර්ථ සම්බන්ධතා රූප සටහන	விரிவாக்கப்பட்ட நிலைபொருள் உறவுமுறை அட்டவணை
114.	feasibility study	ශක්‍යතා අධ්‍යයනය	சாத்தியப்பாடு கற்கை
115.	feedback loop	ප්‍රතිපෝෂණ ලූපය	பின்னூட்டல் வளையம்
116.	fetch-execute cycle	ආහරණ-ක්‍රියාකරවුම් චක්‍රය	தருவிப்பு நிறைவேற்றுச் சுழற்சி
117.	fiber optic	ප්‍රකාශ තන්තු	இழை ஒளியியல்
118.	file	ගොනුව	கோப்பு
119.	file hierarchy	ගොනු ධුරාවලිය	கோப்பு படிநிலை
120.	firewall	ගිනි පවුර	தீச்சுவர்
121.	normal form	ප්‍රථම ප්‍රමත අවස්ථාව	இயல்பாக்கல் வடிவம்
122.	fixed internal hard disk	අචල අභ්‍යන්තර දෘඪ තැටි	நிலையான உள்ளக வன்தட்டு
123.	flash memory	සැණ/ ක්ෂණික මතකය	பளிச்சீட்டு நினைவகம்
124.	flash memory card	සැණ/ ක්ෂණික මතක පත	பளீச்சிட்டு நினைவக அட்டை

125.	flat file system	ඒක ගොනු පද්ධතිය	சமதளக் கோப்பு முறைமை
126.	flip-flop	පිළි-පොළ	எழு-விழு
127.	float	ඉපුලීම/ඉපිලීම	மிதவை
128.	floppy disk	නම්‍ය තැටිය	நெகிழ் வட்டு
129.	flow chart	ගැලීම් සටහන	பாய்ச்சற் கோட்டுப்படம்
130.	folder	ගොනු බහලුම	கோப்புறை
131.	foreign key	ආගන්තුක යතුර	அந்நியச்சாவி
132.	formatting	හැඩසව් ගැන්වීම	வடிவமைத்தல்
133.	frame	රාමුව	சட்டகம்
134.	frequency modulation	සංඛ්‍යාත මූර්ඡනය	அதிர்வெண் பண்பேற்றல்
135.	full adder	පූර්ණාකලකය	முழுமைக் கூட்டி
136.	function	ශ්‍රිතය / කාර්යය	சார்பு
137.	functional dependency	කාර්ය බද්ධ පරායත්තතාව	செயல் சார்புநிலை
138.	functional requirement	කාර්ය බද්ධ අවශ්‍යතාව	செயல்படு தேவை
139.	quantum computing	ක්වොන්ටම් පරිගණනය	சொட்டு கணிப்பு அடிப்படை
140.	gateway	දොරටු මග / වාසල් ද්වාරය /වාහල්දොර	நுழைவாயில்
141.	genetic algorithm	සහජ ඇල්ගොරිදමය	மரபணு வழிமுறை
142.	geographical information system(GIS)	භූගෝලීය තොරතුරු පද්ධතිය /මිහිතැන් තොරතුරු පද්ධතිය	புவியியல் தகவல் முறைமை
143.	graph plotter	ප්‍රස්තාර ලකුණුකරණය	படவரையி
144.	graphic tablet	චිත්‍රකළ්ලකය	வரைவியல் விவரமாக்கி
145.	grid computing	ජාලක පරිගණනය	கோட்டுச்சட்டகக் கணிமை

146.	guided media	නියමු මාධ්‍ය	வழிபடுத்தப்பட்ட ஊடகம்
147.	half adder	අර්ධාකලකය	அரை கூட்டி
148.	hand trace	හස්තානුරේඛනය	கைச் சுவடுகள்
149.	hard disk	දැඩ් තැටිය / දෘඪ ඩිස්කය	வன்தட்டு
150.	hardware	දෘඪාංග	வன்பொருள்
151.	hexadecimal	ෂඩ් දශමය	பதினறுமம்
152.	hierarchical model	ධුරාවලි ආකෘතිය	படிநிலை மாதிரி
153.	host	සත්කාරකය	விருந்தோம்பி
154.	hub	නාභිය	குவியன்
155.	human operator	මිනිස්ක්‍රියාකරුවෝ	மனித இயக்குபவர்
156.	hybrid approach	දෙමුහුන් ප්‍රවේශය	கலப்பு அணுகல்
157.	hyperlink	අධිසම්බන්ධකය	மீ இணைப்பு
158.	Integrated circuits (IC)	අනුකලිත පරිපථ	ஒருங்கிணைந்த சுற்று
159.	icon	නිරූපකය	சிறு படம்
160.	identity	සර්වසාම්‍ය	அடையாளம்
161.	image	රූපය	படிமம்
162.	imperative	විධානාත්මක	கட்டளை
163.	incremental	වර්ධනාත්මක	ஏறுமான, அதிகரிப்பு
164.	indexed allocation	අනුක්‍රමික විභාජනය	சுட்டி ஒதுக்கீடு
165.	information	තොරතුරු	தகவல்
166.	inkjet printer	තීන්ත විදුම් මුද්‍රකය	மைத்-தாரைஅச்சுப்பொறி
167.	instant messaging	ක්ෂණික පණිවුඩ යැවීම	உடனடிச் செய்தியிடல்
168.	integrated development environment)IDE)	සංවෝධනික සංවර්ධන පරිසරය	ஒருங்கிணைந்த விருத்தி சூழல்
169.	integration test	අනුකලන පරීක්ෂණය	ஒருங்கிணைந்த சோதிப்பு
170.	intelligent and	බුද්ධිමත් සහ චිත්තවේගී	நுண்ணறிவும்

	emotional computing	පරිගණනය	உணர்திறனுமிக்க கணித்தல்
171.	interface	අතුරු මුහුණ	இடைமுகம்
172.	internet service provider(ISP)	අන්තර්ජාල සේවය සපයන්නා	இணையச் சேவை வழங்குனர்
173.	interpreter	අර්ථවිනහ්‍යාසකය	மொழிமாற்றி
174.	interrupt	අතුරු බිඳුම	இடையூறு
175.	intranet	අන්තඃජාලය/ අන්තෝජාල	அகவிணையம்
176.	internet of things (IoT)	**සාර්ව ද්‍රව්‍ය අන්තර්ජාලය/ සබැඳි ද්‍රව්‍ය අන්තර්ජාලය**	பொருட்களின் இணையம்
177.	iteration	පුනර්කරණය	மீள் செயல்
178.	karnaugh map	කානෝ සිතියම	கானோ வரைபடம்
179.	knowledge management system(KMS)	දැනුම් කළමනාකරණ පද්ධතිය	அறிவு முகாமைத்துவ முறைமை
180.	large scale integration (LSI)	විශාල පරිමාණයේ අණුකලනය	பாரிய அளவு ஒருங்கிணைப்பு
181.	latency	පමාව/ගුප්තතාව	மறைநிலை
182.	least significant	අඩුමවෙසෙසි	சிறும மதிப்பு
183.	legend	විස්තර පාඨය	குறி விளக்கம்
184.	life cycle of data	දත්ත ජීවන චකුය	தரவு வாழ்க்கை வட்டம்
185.	light emitting diode(LED) display	ආලෝක විමෝචක ඩයෝඩ සන්දර්ශකය	ஒளிகாலும் இருவாயித் திரை / ஒளி உமிழும் இரு முனையம்
186.	linked allocation	සබැඳි විභාජනය	இணைப்பு ஒதுக்கீடு
187.	linker	සන්ධාරකය	இணைப்பி
188.	liquid crystal display(LCD)	ද්‍රවස්ඵටික සන්දර්ශකය	திரவப்பளிங்குக் கணினித் திரை
189.	list	ලැයිස්තුව	பட்டியல்
190.	liveware	ජීවාංග	உயிர் பொருள்

191.	local publishing	ස්ථානීය ප්‍රසිද්ධ කිරීම	உள்ளக வெளியீடு
192.	local area network (LAN)	ස්ථානීය ප්‍රදේශ ජාලය	இடத்துரி வலையமைப்பு
193.	logic gate	තාර්කික ද්වාරය	தர்கப் படலை
194.	Logical Data Modeling(LDM)	තාර්කික දත්ත ආකෘතිකරණය	தர்க்கத் தரவு மாதிரியுருவாக்கல்
195.	logical data structure	තාර්කික දත්ත වූහය	தர்க்கத் தரவுக் கட்டமைப்பு
196.	logical design tools	තාර්කික සැලසුම් මෙවලම්	தர்க்க வடிவமைப்புக் கருவி
197.	looping	ලූපනය	வளைய வரல்
198.	machine code	යන්ත්‍ර කේතය	இயந்திரக் குறியீடு
199.	machine-machine coexistence	යන්ත්‍ර-යන්ත්‍ර සහපැවැත්ම	இயந்திர- இயந்திர ஒருங்கிருத்தல்
200.	magnetic ink character reader(MICR)	චුම්බකිත තීන්ත අනු ලකුණු කියවනය	காந்த மை எழுத்துரு வாசிப்பான்
201.	magnetic stripe reader	චුම්බක තීරු කියවනය	காந்தப்பட்டி வாசிப்பான்
202.	magnetic tape	චුම්භක පටිය	காந்த நாடா
203.	malware	අනිශ්ඨ මාදුකාංග	தீம்பொருள்
204.	management information system (MIS)	කළමනාකරණ තොරතුරු පද්ධතිය	முகாமைத்துவ தகவல் முறைமை
205.	man-machine coexistence	මිනිස්-යන්ත්‍ර සහපැවැත්ම	மனிதன் - இயந்திரம் ஒருங்கிருத்தல்
206.	media access control (MAC)	මාධ්‍ය ප්‍රවේශ පාලක	ஊடக அணுகல் கட்டுப்பாடு
207.	memory management unit) MMU)	මතක කළමනාකරණ ඒකකය	நினைவக முகாமைத்துவ அலகு
208.	mesh topology	බැඳි ස්ථලකය	கண்ணி இடத்தியல்

209.	microprocessor	ක්ෂුද්‍ර සකසනය	நுண்செயலி
210.	microwave	ක්ෂුද්‍ර තරංග	நுண்ணலை
211.	mini disk	කුඩා තැටිය	சிறு வட்டு
212.	mobile computing	ජංගම පරිගණනය	செல்லிடக் கணிமை
213.	mobile marketing	ජංගම අළෙවිකරණය	செல்லிடச் சந்தைப்படுத்தல்
214.	modularization	මොඩියුලකරණය	கூறு நிலையாக்கம்
215.	modulation	මුර්ජනය	பண்பேற்றம்
216.	most significant	වැඩිම වෙසෙසි	அதியுயர் மதிப்பு
217.	mother board	මව් පුවරුව	தாய்ப்பலகை
218.	multi agent systems	බහු කාරක පද්ධති	பல்முகவர் முறைமை
219.	multi user-multi task	බහු පරිශීලක -බහු කාර්යය	பற்பயனர்-பற்பணி
220.	multi-core processors	බහු හර සකසන	பல்கரு செயலி
221.	multimedia objects	බහු මාධ්‍ය වස්තු	பல்லூடக பொருள்
222.	multiplexer	බහු පථකාරකය	பல்சேர்ப்பி
223.	multiplexing	බහු පථකරණය	பல்சேர்ப்பு
224.	multiprocessing	බහු සැකසුම	பன்முறைவழியாக்கி
225.	multitasking	බහුකාර්ය කිරීම	பற்பணி
226.	multi-threading	බහු-අනුත්‍රියායනය	பல் செயல்கூறு
227.	nature inspired computing	ප්‍රකෘති ප්‍රේරිත පරිගණනය/ ප්‍රකෘති අනුප්‍රේරිත පරිගණනය	இயற்கை உள்ளீர்ப்புக் கணிப்பு
228.	nested loop	නීඩිත ලූපය	நீடித்த வளையம்
229.	network addresses translating (NAT)	ජාල යොමු පරිවර්තනය	வலையமைப்பு முகவரி பெயர்ப்பு
230.	network architecture	ජාල නිර්මිතය	வலையமைப்புக் கட்டமைப்பு
231.	network layer	ජාල ස්ථරය	வலையமைப்பு அடுக்கு

232.	network model	ජාල ආකෘතිය	வலையமைப்பு மாதிரி
233.	neural network	ස්නායුක ජාලය	நரம்பியல் வலையமைப்பு
234.	non-functional requirement	කාර්යබද්ධ නොවන අවශ්‍යතාව	செயல்சாராத் தேவைகள்
235.	normalization	ප්‍රමතකරණය	இயல்பாக்கல்
236.	null	අභිශූන්‍ය	வெற்று
237.	object code	වස්තු කේත/	பொருள் குறி
238.	object oriented	වස්තු නැඹුරු / පාදක	பொருள் நோக்குடைய
239.	object- relational model	වස්තු-සම්බන්ධක ආකෘතිය	பொருள் உறவுநிலை மாதிரி
240.	octal	අෂ්ටමය	எண்மம்
241.	office automation system)OAS)	කාර්යාල ස්වයංකරණ පද්ධතිය	அலுவலகத் தன்னியக்க முறைமை
242.	offline	මාර්ග අපගත/ මාර්ගගත නොවන	தொடரறு நிலை
243.	one's compliment	එකෙහි අනුපූරකය	ஒன்றின் நிரப்பி
244.	online	මාර්ගගත	தொடரறா நிலை
245.	open source	විවෘත මූලාශ්‍ර	திறந்த மூலம்
246.	operational feasibility	මෙහෙයුම් ශක්‍යතාව	செயற்பாட்டுச் சாத்தியப்பாடு
247.	operator category	කාරක ප්‍රවර්ගය	செயலி வகை
248.	operator precedence	කාරක ප්‍රමුඛතා	செயலி முன்னுரிமை
249.	optical character reader (OCR)	ප්‍රකාශ අණු ලකුණු කියවනය	ஒளியியல் எழுத்துரு வாசிப்பான்
250.	optical mark reader (OMR)	ප්‍රකාශ ලකුණු කියවනය	காந்த மை எழுத்துரு வாசிப்பான்
251.	output	ප්‍රතිදානය	வெளியீடு
252.	packet switching	පොදි හුවමාරුව	பொதி மடைமாற்றல்
253.	paging	පිටුකරනය	பக்கமிடல்

126

254.	paradigm	සුසමාදර්ශය/ ප්‍රතිමානය/ප්‍රතිරූපය	கோட்பாட்டுச் சட்டகம்
255.	parallel implementation	සමාන්තර ස්ථාපනය	சமாந்தர அமுலாக்கம்
256.	parameter passing	පරාමිති යැවීම	பரமானக் கடத்தல்
257.	parity	සමතාව	சமநிலை
258.	password	මුර පදය	கடவுச்சொல்
259.	payment gateway	ගෙවුම් වාසල් ද්වාරය	பணக் கொடுப்பனவு நுழைவாயில்
260.	periodic refreshing	ආවර්ත ප්‍රබෝධකරණය	காலமுறை புதுப்பித்தல்
261.	peripheral device	පරීයන්ත උපාංගය / උපක්‍රමය	புறச் சாதனம்
262.	phablet	ෆැබ්ලට්	பெப்லட்
263.	phased implementation	අවධිස්ථාපනය / පියවර ක්‍රියාත්මකකිරීම	கட்ட அமுலாக்கல்
264.	phase modulation	කලා මුර්ජනය	நிலை பண்பேற்றம்
265.	phishing	තතුබෑම	வழிப்பறித்தல்
266.	physical layer	භෞතික ස්ථරය	பௌதீக அடுக்கு
267.	physical memory	භෞතික මතකය	பௌதீக நினைவகம்
268.	pilot implementation	නියාමක ස්ථාපනය / නියාමක ක්‍රියාත්මක කිරීම	முன்னோடி அமுலாக்கல்
269.	piracy	චෞරත්වය/ ලුණ්ඨනය	களவு
270.	pirated software	චෞර/ලුණ්ඨිත මෘදුකාංග	திருட்டு மென்பொருள்
271.	plagiarism	ග්‍රන්ථ/රචනා චෞර්‍යය	கருத்துத் திருட்டு
272.	point to point connection	සෘජු ලක්ෂ්‍ය සම්බන්ධතාව	ஒன்றுடனொன்று இணைப்பு
273.	pointing device	දැක්වුම් උපාංගය	சுட்டி சாதனம்
274.	port	කෙවෙනිය	வாயில், துறை
275.	portable external hard disk	ජංගම/සුවහනීය බාහිර දෘඩ තැටිය	காவத்தகு புற வன்தட்டு

276.	portal	ද්වාරය/ ආමුඛද්වාරය	வலைவாசல்
277.	Point of sale (POS) machine	විකුණුම් පොල යන්ත්‍ර	விற்பனை இட இயந்திரம்
278.	postulate	උපකල්පනය	எடுகோள்
279.	power supply	විදුලි සැපයුම/ජව සැපයුම	மின் வழங்கி
280.	presence check	තථ්‍යතා පරීක්ෂාව	இருத்தல் சரிபார்த்தல்
281.	presentation layer	සමර්පන/ඉදිරිපත් කිරීම් ස්ථරය	முன்வைப்பு அடுக்கு
282.	primary key	ප්‍රාථමික/මූල් යතුර	முதன்மைச் சாவி
283.	primitive data type	ප්‍රාථමික දත්ත වර්ගය	பூர்வீகத் தரவு வகை
284.	privacy	පෞද්ගලිකත්වය	அந்தரங்கம்
285.	private key	පෞද්ගලික යතුර	பிரத்தியேகச் சாவி
286.	process	ක්‍රියාවලිය/ක්‍රියායනය/ සැකසුම	செயல்/ முறைவழியாக்கல
287.	process control block(PCB)	ක්‍රියායන පාලන බණ්ඩය	செயல் கட்டுப்பாட்டுத் தொகுதி
288.	process management	ක්‍රියායන කළමනාකරණය	செயல் முகாமைத்துவம்
289.	process states	ක්‍රියායන තත්ත්ව	செயல் நிலை
290.	process transition	ක්‍රියායන සංක්‍රමණය	செயல் நிலைமாறல்
291.	product commercialization	නිෂ්පාදන වාණිජ්‍යකරණය	தயாரிப்பு வர்த்தகமயமாக்கல்
292.	product of sum (POS)	ඒකඝයන්ගේ ගුණිතය	கூட்டுத்தொகையின் பெருக்கம்
293.	program translator	ක්‍රමලේඛ පරිවර්තක	செய்நிரல் மொழிபெயர்ப்பான்
294.	proprietary	හිමිකම් සහිත	தனியுரிமை
295.	protocol	නියමාවලිය	நடப்பொழுங்கு
296.	prototyping	මූලාකෘතිකරණය	மூலவகை மாதிரி
297.	proxy server	නියෝජන සේවාදායකය	பதிலாள் சேவையகம்
298.	pseudo code	ව්‍යාජ කේතය	போலிக்குறி

299.	public switch telephone network (PSTN)	පොදු ස්වීච දුරකථන ජාලය	பொது ஆளியிடப்பட்ட தொலைபேசி வலையமைப்பு
300.	public key	පොදු යතුර	பொதுச் சாவி
301.	pulse code modulation	ස්පන්ද කේත මුර්ජනය	துடிப்புக்குறி பண்பேற்றம்
302.	pulse width modulation	ස්පන්ද විතර මුර්ජනය	துடிப்பு அகலப் பண்பேற்றம்
303.	radio button	විකල්ප තේරීම	ரேடியோ பொத்தான்
304.	random access memory)RAM)	සසම්භාවී ප්‍රවේශ මතකය	தற்போக்கு அணுகல் நினைவகம்
305.	range check	පරාස පරීක්ෂාව	வீச்சு சரிபார்த்தல்
306.	rapid application development (RAD)	ශීඝ්‍ර යෙදවුම් සංවර්ධනය	துரித பிரயோக விருத்தி
307.	read only memory (ROM)	පඨන මාත්‍ර මතකය	வாசிப்பு மட்டும் நினைவகம்
308.	real time	තාත්‍ය කාලික	நிகழ்நேரம்
309.	record	උපලැකියාන	பதிவு
310.	redo	නැවත කිරීම	மீளச் செய்
311.	redundancy	සමතිරික්තතාව	மிகைமை
312.	reference model	යොමු ආකෘතිය	வலையமைப்பின் கட்டமைப்பு
313.	refreshing	පුබුදු කිරීම	புத்துயிர்ப்பித்தல்
314.	register memory	රෙජිස්තර මතකය	பதிவகம்
315.	relational	සම්බන්ධක	தொடர்பு, உறவுநிலை
316.	relational model	සම්බන්ධක ආකෘතිය	உறவுநிலை மாதிரி
317.	relational database	සම්බන්ධක දත්ත සමුදාය	உறவுநிலை தரவுத்தளம்
318.	relational instance	සම්බන්ධතා නිදර්ශනය	தொடர்பு முறை எடுத்துக்காட்டு
319.	relational schema	සම්බන්ධතා පරිපාටික සටහන	தொடர்பு முறைத் திட்டம்

320.	relationship	සම්බන්ධතාවය	தொடர்புமுறை
321.	remote	දුරස්ථ	தொலை, தூர
322.	render	විදැහු	வழங்கு
323.	repeater	පුනර්කථකය	மீளி, மீட்டி
324.	repetition	පුනරුක්තිය	மீள் செயல்
325.	reset button	ප්‍රත්‍යාරම්භ බොත්තම	மீளமைப்புப் பொத்தான்
326.	retrieve	සමුද්ධරණ	மீளப்பெறு
327.	return value	ප්‍රත්‍යාගමන අගය	திரும்பல் பெறுமானம்
328.	reverse auction	ප්‍රතිවෙන්දේසිය	எதிர்மாற்று ஏலம்
329.	ring topology	මුදු ස්ථලකය	வளைய இடத்தியல்
330.	router	මං හසුරුව	வழிப்படுத்தி, வழிச்செலுத்தி
331.	routing	මං හැසිරවීම	வழிச்செலுத்தல்
332.	scanner	සුපිරික්සකය	நுணுகு நோக்கி
333.	scheduler	නියමකරණය	ஒழுங்குபடுத்தி
334.	scope of variable	විචල්‍ය පරාසය	மாறி செயற்பரப்பு
335.	query	විමසුම	வினவல்
336.	selection	තේරීම	தெரிவு
337.	selector	වරකය	தேர்வி, தேர்ந்தெடுப்பி
338.	sensor	සංවේදකය	உணரி
339.	sequence	අනුක්‍රමය	தொடர்
340.	sequential circuit	අනුක්‍රමික පරිපථය	தொடர்ச் சுற்று
341.	sequential search	අනුක්‍රමික සෙවුම	வரிசைமுறைத் தேடல்
342.	server	සේවාදායකය / අනුග්‍රාහකය	சேவையகம்
343.	session layer	සැසි ස්ථරය	அமர்வு அடுக்கு
344.	sharable pool	හුවමාරු පුංජය	பகிரதகு பொது இடம்
345.	sign-magnitude	ලකුණුවත් ප්‍රමාණය / සංලක්ෂිත පරිමාණය / අංකිත	குறியுடைய வீச்சளவு

		පරිමාණනය	
346.	single user-multi task	ඒක පරිශීලක-බහු කාර්යය	தனிப்பயனர்-பற்பணி
347.	single user-single task	ඒක පරිශීලක-ඒක කාර්යය	தனிப்பயனர்-தனிப்பணி
348.	smart card	සුහුරු කාඩ්පත	சூட்டிகை அட்டை
349.	smart phone	සුහුරු දුරකථනය	சூட்டிகைத் தொலைபேசி
350.	smart system	සුහුරු පද්ධතිය	சூட்டிகை முறைமை
351.	social networking	සමාජ ජාලකරණය	சமூக வலையமைப்பாக்கல்
352.	software	මෘදුකාංග	மென்பொருள்
353.	software agent	මෘදුකාංග කාරක	மென்பொருள் முகவர்
354.	sort	තේරීම	வரிசைப்படுத்து
355.	source	ප්‍රභව	மூலம்
356.	spiral model	සර්පිල ආකෘතිය	சுருளி மாதிரி
357.	spooling	ඒතීම	சுற்றுதல்
358.	Star topology	තාරකා ස්ථලකය	வின்மீன் இடத்தியல்
359.	stepwise refinement	පියවරාකාර පිරිපහදුව	படிமுறை நீக்கல்
360.	storage	ආචයනය	சேமிப்பு
361.	storage allocation	ආචයන විභාජනය	சேமிப்பு ஒதுக்கல்
362.	stored program concept	ආචිත ක්‍රමලේඛ සංකල්පය	சேமிக்கப்பட்ட செய்நிரல் எண்ணக்கரு
363.	structure	වූහය	கட்டமைப்பு
364.	structure chart	වූහ සටහන	கட்டமைப்பு வரைபு
365.	structured	වූහගත	கட்டமைப்புடைய
366.	structured query language(SQL)	වූහගත විමසුම් බස	கட்டமைப்பு வினவல் மொழி
367.	submit button	යොමු බොත්තම	சமர்ப்பித்தல் பொத்தான்
368.	subnet mask	උප ජාල ආවරණය	உபவலை மறைமுகம்

369.	sub-netting	උප-ජාලනය	உபவலையமைப்பு
370.	sub-program	උප-ක්‍රමලේඛය	துணைச் செய்நிரல்
371.	sum of products (SOP)	ගුණිතයන්ගේ ඒකඝය	பெருக்கங்களின் கூட்டுத்தொகை
372.	supply chain management	සැපයුම් දාම කළමනාකරණය	விநியோக சங்கிலித்தொடர் முகாமைத்துவம்
373.	swapping	ප්‍රතිහරණය	இடமாற்றல்
374.	switch	ස්විච්ය	ஆளி
375.	syntax	කාරක රීති	தொடரியல்
376.	system development life cycle(SDLC)	පද්ධති සංවර්ධන ජීවන චක්‍රය	முறைமை விருத்தி வாழ்க்கை வட்டம்
377.	table	වගුව	அட்டவணை
378.	table check constraint	වගු පරීක්ෂා සංරෝධකය	அட்டவணை சரிபார்த்தல் கட்டுப்பாடு
379.	tag	උසුලනය	ஒட்டு
380.	Technical feasibility	තාක්ෂණික ශක්‍යතාව	தொழினுட்பச் சாத்தியக் கற்கை
381.	telecommuting	දුරස්ථ සංවාදය / දුර සන්නිවේදනය	தொலைசெயல்
382.	testing strategy	පරීක්ෂණ උපක්‍රමය	பரீட்சித்தல் உபாயம்
383.	text and font	පාඨ සහ අක්ෂර	வாசகமும் எழுத்துருவும்
384.	text formatting	පාඨ හැඩසව් ගැන්වීම	வாசக வடிவமைப்பு
385.	text input	පාඨ ආදාන	வாசக உள்ளீடு
386.	normal form	ප්‍රමත අවස්ථාව	இயல்பாக்கல் வடிவம்
387.	thumbnail	සැකෙව් රූ	குறும்படம்
388.	time division modulation (TDM)	කාල බෙදුම් මූර්ඡනය	நேரப் பிரிவுப் பண்பாக்கம்
389.	time sharing	කාල විභජනය	நேரப்பகிர்வு
390.	timing	කාල ගණනය	நேரக்கணிப்பு

391.	top down design	මුදුන් බිම් සැලසුම	மேலிருந்து கீழான வடிவமைப்பு
392.	touch pad	ස්පර්ශක උපධානය / පාදකය	தொடு அட்டை
393.	touch screen	ස්පර්ශක තිරය	தொடுதிரை
394.	transaction processing system(TPS)	ගනුදෙනු සැකසුම් පද්ධතිය	பரிமாற்றச் செயலாக்க முறைமை
395.	transitive dependency	සංක්‍රාන්ති පරායත්තතාව	மாறும் சார்பு நிலை
396.	transport layer	ප්‍රවාහන ස්ථරය	போக்குவரத்து அடுக்கு
397.	transport protocol	ප්‍රවාහන නියමාවලිය	போக்குவரத்து நடப்பொழுங்கு
398.	tuple	උපලැකියාන/පේළිය	பதிவு/நிரை
399.	twisted pair	ඇඹරි යුගල	முறுக்கிய சோடி
400.	two's compliment	දෙකෙහි අනුපූරකය	இரண்டின் நிரப்பி
401.	type check	ප්‍රරූප පරීක්ෂාව	வகை சரிபார்த்தல்
402.	constraint	සංරෝධනය	கட்டுப்பாடு வகை
403.	ubiquitous computing	සර්වවර්ති ආගණනය	எங்கும் வியாபித்த கணிமை
404.	undo	අහෝසි කිරීම	செயல்தவிர்
405.	unguided media	නියමු නොවන මාධ්‍ය	வழிபடுத்தப்படாத ஊடகம்
406.	uni-casting	සෘජු සම්ප්‍රේෂණය	தனிப்பரப்பல்
407.	unicode	යුනිකෝඩ්/ ඒකකේත	ஒற்றைக்குறி முறை
408.	unique constraint	අනන්‍ය සංරෝධකය	தனித்துவக் கட்டுப்பாடு
409.	unit testing	ඒකක පරීක්ෂණය	அலகுச் சோதனை
410.	universal	සාර්වත්‍ර	பொது
411.	updating	යාවත්කාලීන කිරීම	தற்காலப்படுத்தல்
412.	user	පරිශීලක	பயனர்
413.	user defined	පරිශීලක නිර්වාචිත	பயனர் வரையறை

414.	validation	වලංගු කිරීම	செல்லுபடியாக்கல்
415.	variable	විචල්‍යය	மாறி
416.	very large scale integration (VLSI)	ඉතා විශාල පරිමාණයේ අනුකලිත	மிகப் பெரியளவிலான ஒருங்கிணைப்பு
417.	video graphic adapter (VGA)	දෘශ්‍ය චිත්‍රක අනුහුරුකුරුව	காணொளி வரையி பொருத்தி
418.	virtual community	අතථ්‍ය ප්‍රජාව	மெய்நிகர் சமூகம்
419.	virtual memory	අතථ්‍ය මතකය	மெய்நிகர் நினைவகம்
420.	virtual storefront	අතථ්‍ය වෙළඳ ප්‍රදර්ශනාගාරය	மெய்நிகர் கடைமுகப்பு
421.	waterfall model	දියඇලි ආකෘතිය	நீர் வீழ்ச்சி மாதிரி
422.	wave length	තරංග ආයාමය	அலை நீளம்
423.	web portal	වෙබ් ද්වාරය	வலை வாசல்
424.	web server	වෙබ් සේවාදායකය	இணைய சேவையகம்
425.	web service provider	වෙබ් සේවා සැපයුම්කරු	இணைய சேவை வழங்குனர்
426.	white box testing	ස්වේත මංජුසා පරීක්ෂාව	வெண்பெட்டிச் சோதிப்பு
427.	world wide web(WWW)	ලෝක විසිරි වියමන	உலகளாவிய வலை
428.	uniform resource locator (URL)	ඒකාකාරී සම්පත් නිශ්චායකය	சீர்மை வள இருப்பிடங்காட்டி
429.	uniform resource identifier(URI)	ඒකාකාරී සම්පත් හඳුන්වනය	சீர்மை வள அடையாளங்காட்டி