

CURRICULUM

**Internet of Things Software Development
GRADE IX-X
2021**



GOVERNMENT OF PAKISTAN

Ministry Of Federal Education and Professional Training

ISLAMABAD

Contents

INTRODUCTION	3
Grade-IX – Internet of Things Software Development	6
Grade-X – Internet of Things Software Development.....	16
Formative (Internal) Assessment.....	23
Methods for Internal/Formative Assessment	23
Summative /External Assessment.....	24
Guideline for planning and writing a chapter	25
Guidelines for Writing Learner Workbook	26

INTRODUCTION

The Internet of Things (IoT) is a network of resource constrained nodes being capable of automating an existing manual procedure. This IoT network is also connected to the internet to enable ease of access and user friendly configuration and monitoring. An IoT developer is an expert who completely understands the IoT network, its different components and their working. IoT developer is capable of programming sensor and hardware devices. IoT developer is capable of developing a hardware and software for IoT edge devices. He is also trained of sending the data to the cloud server. IoT developer is a specialist in utilizing resource constrained devices. IoT cloud developer is an expert who can install and configure Virtual machines on the cloud. While IoT Data scientist is the one who utilizes the data received on the cloud and saves it efficiently in the databases to train Machine Learning algorithms. IoT security is one of the hot research topic nowadays which will create many skill based jobs in the near future. An IoT developer is incomplete without the understanding and hands on experience of security protocols. In a nutshell, IoT is the start of art technology to automate the industrial, commercial and domestic procedures and there is a need to develop the resources with the required IoT skills which will not only benefit the industry but also create job opportunities for the individuals.

IoT is an ever changing field. The number of IoT nodes are increasing each day and hence their monitoring, upgrading and security needs. Therefore, industry requirement for skilled workforce is increasing which can only be managed through setting relevant competency standards in collaboration with the leading industries.

Rationale

In a world dominated by digital technology, IoT has become the most important development of 21st century. IoT has come to play a prominent role in our lives by linking several systems to give smart performances in every task. It has created evolution of devices and applications impeccably integrated human communication in ways we never expected before. IoT as an emerging paradigm, will continue to pick up steam as more businesses realize the potential of connected devices to keep them competitive. IoT has been acknowledged as one of the foundation stones of Industry due to its potential to change the existing industrial and business processes. With the advent and growth of the IoT, physical environments are becoming smarter and more interconnected than ever before. This has changed the way we live by improving sustainability, efficiency, accuracy, and economy in almost every aspect of our lives. IoT has been leveraged in many industries such as healthcare systems, traffic management, energy management, education, environment monitoring, smart homes, and smart cities.

The Trade of Internet of Things is a profession that is increasingly getting attention in Pakistan because of the population growth and the resultant immense opportunities in this technology trade not only among the youth seeking to enter the industry but also among adults who wish to polish their skills to develop a career out of it.

This course aims to enable students to acquire a set of knowledge and concepts, and develop a range of technical, personal, interpersonal, organizational, and generic skills, that can be applied in various contexts, both within and related to trade of IoT domain. Furthermore, this course will stimulate the learners towards entrepreneurship in the industry.

Within this qualification relating to IoT interventions in schools, there are important interventions integrated within school settings. The purpose of this qualification is to strengthen connections between schools and trade and drawing on the concept of the socio technical network, theories the interactions between the relevant market and school contexts.

Internet of Things, Matric Tech (9th&10th)

Aims and Objectives

The specific aims of developing IoT qualification are:

- To Promote skills of the youth to maximize employment opportunities at national and international level.
- To provide skillful manpower for IoT based near future life.
- To mold students to develop skills about the use of IoT in daily life devices and make some new innovative devices.
- To recognize the factors contributing to the emergence and future trends of IoT within broader ICT industry.
- To examine the potential business opportunities that IoT can uncover.
- To capture and generate value from the application and use of IoT technologies.
- To provide students with a smooth transition to work.
- To enable students to construct a personal roadmap to gain strategic advantage from IoT.

Objectives

After completing this, the students will be able to:

- Explain Internet of Things in different contexts.
- Take account of the key components that make up an IoT system.
- Learn the concept and capabilities of smart thing and physical principles of sensing.
- Explore IoT enabling technologies, architectures, and standards.
- Acquire the basic competence of IoT Hardware and Software development
- Identify infrastructure for IoT developments.
- Apply IoT knowledge to implement small-scale IoT Project.
- Design, build and integrate IoT platforms, incorporating different types of sensors and actuators, micro-controllers, and devices.
- Understand IoT protocol stack and fundamentals of Social IoTs.

Grade-IX – Internet of Things Software Development

Learning Themes and Students' Learning Outcomes Knowledge, Skills and Attitude					
Chapter 01 (Introduction to IoT)					
T= 4, P= 3, Total= 7					
Content/Themes	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction	The Students will be able to: <ul style="list-style-type: none"> define IoT. know different components of IoT <ul style="list-style-type: none"> networking messaging hardware understand the importance of IoT. evolution of IoT 	<ul style="list-style-type: none"> Identify different components of IoT by using images Presentation on evolution of IoT 	2 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system NodeMCU (ESP8266, ESP32) Working IoT setup (End Node, IoT gateway, GUI) 	Classroom / Lab
Scope	The Students will be able to: <ul style="list-style-type: none"> know the scope of IoT in domestic, commercial, & industrial applications. 	<ul style="list-style-type: none"> Invite guest speaker from IoT to address the students to highlight scope and importance of IoT 	1 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system 	Classroom / Lab
Application	The Students will be able to: <ul style="list-style-type: none"> learn different IoT applications understand high level (basic) working of smart home system, remote monitoring system, smart cities 	<ul style="list-style-type: none"> Identify real life IoT applications. 	1 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system Working IoT setup (End Node, IoT gateway, GUI) 	Classroom / Lab
Chapter 02 (Operating System (Windows and Linux))					
T = 6, P = 10, Total = 16					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction	The students will be able to: <ul style="list-style-type: none"> define software learn types of software <ul style="list-style-type: none"> system software application software define operating system 	<ul style="list-style-type: none"> Classify the type of given software Presentation on different components of specific operating system Or on the differences of various types of operating systems 	2 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system 	Classroom / Lab

	<ul style="list-style-type: none"> define basic components of operating system (scheduler, file system, memory manager, etc.) describe various types of operating systems <ul style="list-style-type: none"> Windows Linux understand firmware 				
Operating System installation	<p>The Students will be able to:</p> <ul style="list-style-type: none"> understand Installation of OS (windows and linux) describe different steps of installation process <ul style="list-style-type: none"> boot from storage media (DVD, Mass storage, external hard disk etc.) partitioning and formatting. selecting appropriate drive install device driver install operating system on virtual machine 	<ul style="list-style-type: none"> Install windows on a new volume with NTFS file system Install linux on a given system Create a linux virtual machine on windows based PC 	1 Periods (T) 4 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system Bootable linux image Bootable windows image 	Classroom / Lab
Operating System usage	<p>The Students will be able to:</p> <ul style="list-style-type: none"> know copying, moving, rename files and folders search files and folders personalize desktop settings personalize display settings know files extensions hide / unhide files / folders / system files use device manager use task manager use command prompt install application software on window 	<ul style="list-style-type: none"> Create new directory according to given properties Install device driver of printer Create, copy, move, and rename files and folders using command prompt 	2 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system Bootable linux image Bootable windows image 	Classroom / Lab
Updating and upgrading OS	<p>The students will be able to:</p> <ul style="list-style-type: none"> know updating and upgrading differentiate between updating and upgrading understand the process of updating <ul style="list-style-type: none"> hard drive free space checking available OS update online 	<ul style="list-style-type: none"> Update Windows Update Linux 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system Bootable linux image Bootable windows image 	Classroom / Lab

	<ul style="list-style-type: none"> ○ downloading and applying updates to the OS • understand the process of upgrading; <ul style="list-style-type: none"> ○ hard drive free space ○ booting from storage media (DVD, Mass storage, external hard disk etc.) or internet ○ selecting appropriate drive 				
Chapter 03 (Computer networks)					
T = 12, P = 13, Total = 25					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction to Computer Networks	The students will be able to: <ul style="list-style-type: none"> • define computer networks. • describe importance of computer network • understand the basic types of computer network (LAN, WAN, MAN, PAN etc.) • describe the basic knowledge of components used in networks. • know and understand the communication media: unshielded twisted-pair (UTP), shielded twisted pair (STP), fiber optics and coaxial cable. wireless media. • differentiate wired and wireless network • describe terminologies used in computer network (data rate, Baud, Bit, Kbps, attenuation etc.) 	<ul style="list-style-type: none"> • Presentation of Various network types. • Group discussion on communication media and their characteristics. • Identify network components. 	4 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> • Network cable CAT5,CAT6 • Computer system • Networking Tools. • Multimedia projector • Switchers • Router • Wireless router 	Class room and Lab
Network cables	The students will be able to: <ul style="list-style-type: none"> • understand types of cables used in networking • differentiate straight and cross cable. • color coding of network cable • know and understand of connectors: RJ45, RJ-11, BNC. • make cross wired and straight through connection. 	<ul style="list-style-type: none"> • Identify the cable used for network type (Straight through, cross cable) • Identify networking tools. • Create a network cable by selecting appropriate length, type and connector. 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> • Network cable CAT5,CAT6 • Computer system • Networking Tools. • Multimedia projector • Switchers • Router • Wireless router • Cable Tester • Cable connectors 	Class room and Lab

	<ul style="list-style-type: none"> • know about use of cable tester to test cable connector. • understand fixing a cable and connector issue. 			<ul style="list-style-type: none"> • Cable punching tool 	
Switches and routers	<p>The students will be able to:</p> <ul style="list-style-type: none"> • know and understand of network components: modems, hubs, switches, bridges, routers, firewall, gateways, repeaters, transceivers, wireless access point, etc. – their types, functions, advantages and applications • understand switches and router interfaces. • know about wireless networks and devices. • describe computer network topologies. • describe and differentiate active and passive network components. • configure router settings. • know about connecting cables with networking devices. 	<ul style="list-style-type: none"> • Discussion on Networking components and their uses. • Assign host name to a router. • Assign name to a wireless router. • Configure a router in station mode and access point mode • Create a wired network using devices (router/ switches). 	3 Periods (T) 5 Periods (P)	<ul style="list-style-type: none"> • Network cable CAT5,CAT6 • Computer system • Multimedia projector • Switchers • Router • Wireless router • Cable Tester 	Class room and Lab
Network configuration	<p>The students will be able to:</p> <ul style="list-style-type: none"> • understand network configuration • know about network protocols (TCP / IP), OSI model, IPv4, IPv6, physical addresses (MAC Addresses) of network devices. • know about Static and dynamic IP. • understand of DHCP • know Setting of: <ul style="list-style-type: none"> ○ IP Address(IP4/IP6) & ○ subnet mask, ○ gateway ○ classes of IP addressing ○ network address ○ DHCP • connect computer to internet. 	<ul style="list-style-type: none"> • Presentation on OSI Model. • Assign IP Address to computer system, and routers. • Configure dynamic IP range on router. 	3 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> • Network cable CAT5, CAT6 • Computer system • Multimedia projector • Switchers • Router • Wireless router • Cable Tester 	Class room and Lab
Trouble Shoot Network	<p>The students will be able to:</p> <ul style="list-style-type: none"> • know about commands used in testing network (ping etc) • check the Internet connectivity using router interface. 	<ul style="list-style-type: none"> • Ping all network nodes to check the connectivity. 	1 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> • Computer system • Multimedia projector • Switchers • Router 	Class room and Lab

				<ul style="list-style-type: none"> • Wireless router • Cable Tester • Network 	
Chapter 04 (Basics of programming Language)					
T= 4, P= 5 Total=9					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction	The students will be able to: <ul style="list-style-type: none"> • describe computer languages • explain types of languages <ul style="list-style-type: none"> ○ low level language ○ high level language • use of different languages for different applications 	<ul style="list-style-type: none"> • Identify application of high level languages • Identify application of low level languages 	1 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system 	Class and Lab
Language translators	The students will be able to: <ul style="list-style-type: none"> • define translational software • understand types of translational software <ul style="list-style-type: none"> ○ assembler ○ interpreter ○ compiler • understand computer programming cycle <ul style="list-style-type: none"> ○ coding ○ translation ○ execution ○ debugging • explain IDE 	<ul style="list-style-type: none"> • Draw flow of programming cycle in MS word 	2 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> • Notebooks • White board • Multimedia • Internet • Computer system 	
Flow charts	The students will be able to: <ul style="list-style-type: none"> • define flow chart • understand symbols of flow chart • design flow diagram for a simple problem (addition, subtraction, multiplication, division, and condition (if else)) 	<ul style="list-style-type: none"> • Construct flow chart (addition of numbers) • Construct flow chart of problem containing conditional statements 	1 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system 	
Chapter 05 (Introduction to C)					
T= 29, P= 50, Total= 79					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction	The students will be able to: <ul style="list-style-type: none"> • describe C • understand structure of C program 	<ul style="list-style-type: none"> • Presentation on structure of C program • Draw life cycle of C program on MS Word 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system 	Classroom and Lab

	<ul style="list-style-type: none"> o header file o main function • understand life cycle of c program o coding o compiling o code optimization o linking o execution o debugging 				
Programming Environment setup	The students will be able to: <ul style="list-style-type: none"> • define integrated development environment (IDE) • install C Compiler and IDE • develop a program of printing hello world in Programming language C/C++. 	<ul style="list-style-type: none"> • Write and execute a “hello world” program in C 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for C language 	Classroom and Lab
Input output statements	The students will be able to: <ul style="list-style-type: none"> • understand input and output statements • use printf statement • use scanf statement • understand of format specifier for printf and scanf statement 	<ul style="list-style-type: none"> • Take integer input from a user and print it • Display integer using various format specifier 	1 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for C language 	Classroom and Lab
Arithmetic statements	The students will be able to: <ul style="list-style-type: none"> • understand data types and variable • understand mathematical operators available in C <ul style="list-style-type: none"> o unary operators o binary operators • understand precedence of operators • implement arithmetic expression in C. 	<ul style="list-style-type: none"> • Implement a program to add and multiply two numbers taken from user and display result • Implement a program that take a small alphabet from user and display the capital equivalent of it. • Implement a program to convert temperature from Centigrade to Farenheit 	5 Periods (T) 9 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for C language 	Classroom and Lab
Decision control statements	The students will be able to: <ul style="list-style-type: none"> • describe conditional statements and its types <ul style="list-style-type: none"> o if statement o if else statement o switch statement • understand nested decision statements. • implement Decision Control program in C 	<ul style="list-style-type: none"> • Write a program to calculate the grade of a student based on entered marks • Write a program using switch statement that asks the user for two numbers and the arithmetic operation (+,-,/,*) to perform on them and display result accordingly • Write a program to find the largest and smallest among three entered numbers and also display whether the identified 	6 Periods (T) 8 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for C language 	Classroom and Lab

		<p>largest/smallest number is even or odd.</p> <ul style="list-style-type: none"> Write a program to check whether input alphabet is vowel or not using if-else and switch statement. 			
Loops	<p>The students will be able to:</p> <ul style="list-style-type: none"> define concept of loop describe FOR Loop in C describe WHILE Loop in C describe DO-WHILE Loop in C understand handling control variables for a loop understand breaking a loop implement FOR loop program in C understand nested loop 	<ul style="list-style-type: none"> Write a program to generate first 10 multiples of any given number Write a program to draw write angle triangle using asterisk (*) Write a program to implement an arithmetic calculator using loop Write a program to input two integer numbers and display the sum of even numbers between these two input numbers. 	6 Periods (T) 9 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system IDE for C language 	Classroom and Lab
Functions	<p>The students will be able to:</p> <ul style="list-style-type: none"> describe functions and its types understand return types understand parameters use built-in function 	<ul style="list-style-type: none"> Write a program to solve quadratic equation based on input Write a program to calculate trigonometric identities for any given angle Write a program that takes base and exponent values from user and calculate power 	4 Periods (T) 8 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system IDE for C language 	Classroom and Lab
Arrays	<p>The students will be able to:</p> <ul style="list-style-type: none"> describe concepts of array describe data types of arrays and its declaration explain indexing and access of array understand “string” 	<ul style="list-style-type: none"> Write a program to store ten values from user in an array Write a program to find a given integer value in an array already filled with integers Write a program to read a sentence and count the number of characters & words in that sentence. 	5 Periods (T) 9 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system IDE for C language 	Classroom and Lab
Chapter 06 (Computer Security)					
T= 14, P= 17, Total= 31					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction to Computer Security	<p>The students will be able to:</p> <ul style="list-style-type: none"> define computer security, define cyber security, 	<ul style="list-style-type: none"> Presentation on common computer security issues and their implications. 	3 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet 	Classroom and Lab

	<ul style="list-style-type: none"> differentiate computer and cyber security understand information system and information system assets. describe importance of computer security understand threats to information system assets. describe attack vector, understand malware and its type describe losses in cases security attack. understand the terminologies <ul style="list-style-type: none"> hackers/intruder crackers security expert. vulnerability. risk. 	<ul style="list-style-type: none"> Classify computer threats and attacks Group discussion on Malware and their types. 		<ul style="list-style-type: none"> Computer system 	
Features of a Secure System	<p>The students will be able to:</p> <ul style="list-style-type: none"> understand the basic of: <ul style="list-style-type: none"> confidentiality, integrity, authentication, availability, non repudiation accountability. understand basic techniques used for <ul style="list-style-type: none"> confidentiality, integrity, availability 	<ul style="list-style-type: none"> Discussion on differentiate features of secure system. 	2 Periods (T) 1 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system 	Classroom and Lab
Information System protection	<p>The students will be able to:</p> <ul style="list-style-type: none"> understand protection. describe various tools used to protect information system from intruders and hacker. understand anti malware software and firewall select appropriate anti malware software. download and Install anti malware software online and from DVD/CD update anti malware database/repository perform complete malware scan on any system. 	<ul style="list-style-type: none"> Install an anti-malware application on personal computer. Scan a computer system with antivirus and delete identified virus. Install a firewall on computer system and configure access control list 	5 Periods (T) 6 Periods (P)	<ul style="list-style-type: none"> Computer system Multimedia projector Antivirus Firewall software Internet Computer Network 	Classroom and Lab

	<ul style="list-style-type: none"> • detect the malware present on hard disk. • delete / quarantine all the malware successfully which are detected as a result of scan. • know well-known firewalls • understanding and knowledge of: <ul style="list-style-type: none"> ◦ users account, privileges setting, IP, zones, Inbound and Outbound traffic, Ports and ACL. • describe process of configuring a firewall for: <ul style="list-style-type: none"> ◦ deletion of default account, ◦ creation/renaming an account ◦ ensuring password protection. ◦ privileges setting. ◦ IP setting ◦ setting zones ◦ setting inbound and outbound setting and its importance. ◦ access control list • knowledge of logging services in firewall. • describe reports and logs and explain its importance. 				
Data protection	<p>The students will be able to:</p> <ul style="list-style-type: none"> • know about encryption and decryption. • understand encryption tools used in windows. • perform encryption of drive data using encryption tool. 	<ul style="list-style-type: none"> • Perform encryption of drive using Windows encryption tool. 	2 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> • Computer system • Multimedia projector • Encryption software • Internet • Computer Network 	Classroom and Lab
Creating backups	<p>The students will be able to:</p> <ul style="list-style-type: none"> • understand backup and restore. • know importance of schedule backup. • describe tools used in windows for backup and restore. • perform backup a data • perform restoring a data. 	<ul style="list-style-type: none"> • Create a disk backup using windows based tool and perform restore function. 	2 Periods (T) 4 Periods (P)	<ul style="list-style-type: none"> • Computer system • Multimedia projector • Backup software • Internet • Computer Network 	Classroom and Lab

Chapter 07 (Communication Skills)					
T = 6, P = 7, Total = 13					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Communication and its Types	The students will be able to: <ul style="list-style-type: none"> • know about communication process • understand types of communication (verbal/ non-verbal) • understand effective communication skills • identify obstacles in communication • communicate effectively in a team environment • know about barrier of communication (cultural barriers, language barriers, gender barriers) 	<ul style="list-style-type: none"> • Role play on communication process of sender and receiver with interruption • Group Presentation on communication barrier 	3 Periods (T) 2 Period (P)	<ul style="list-style-type: none"> • Multimedia 	Classroom
Effective email writing	The students will be able to: <ul style="list-style-type: none"> • create, access and manage email account • learn how to write and respond official email 	<ul style="list-style-type: none"> • Create email account • Write an official email to school principal on subject of any importance 	2 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> • Multimedia • System, • Internet connection 	Classroom
Introduction to Social Media Platforms <ul style="list-style-type: none"> ○ Facebook, ○ Instagram ○ Twitter, ○ YouTube 	The students will be able to: <ul style="list-style-type: none"> • role of social media in marketing and business development • merits and de-merits of social media 	<ul style="list-style-type: none"> • Create social media page for your self 	1 Periods (T) 3 Period (P)	<ul style="list-style-type: none"> • System, • Internet connection 	Classroom

Grade-X – Internet of Things Software Development

Learning Themes and Students' Learning Outcomes Knowledge, Skills and Attitudes					
Chapter 01 (Scripting Python)					
T = 16, P = 22, Total = 38					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction	The students will be able to: <ul style="list-style-type: none"> describe Python describe structure of Python program know life cycle of Python program <ul style="list-style-type: none"> coding interpreting / compiling execution debugging difference between script and a program 	<ul style="list-style-type: none"> Discussion on structure and life cycle of Python Presentation on difference between script and program 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system 	Classroom and Lab
Programming Environment setup	The students will be able to: <ul style="list-style-type: none"> install Python interpreter describe coding conventions of Python use Python's interactive prompt write and execute stored program in Python 	<ul style="list-style-type: none"> Write instruction to print 'hello world' in Python interactive prompt Write and execute a program that prints "hello world" in Python 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system IDE for Python language 	Classroom and Lab
Input output statements	The students will be able to: <ul style="list-style-type: none"> use print statement use input statement 	<ul style="list-style-type: none"> Take integer input from a user and print it Write a program that asks user for his/her Name and then greets the user with the provided Name 	1 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system IDE for Python language 	Classroom and Lab
Arithmetic statements	The students will be able to: <ul style="list-style-type: none"> understand data types and variable understand mathematical operators available in Python <ul style="list-style-type: none"> unary operators binary operators understand precedence of operators implement arithmetic expression in Python. 	<ul style="list-style-type: none"> Implement a program to add and multiply two numbers taken from user and display result Implement a program to convert temperature from Centigrade to Fahrenheit 	2 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system IDE for Python language 	Classroom and Lab
Decision control	The students will be able to: <ul style="list-style-type: none"> describe conditional statements and its types 	<ul style="list-style-type: none"> Write a program to calculate the grade of a student based on entered marks 	3 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> White board Multimedia 	Classroom and Lab

	<ul style="list-style-type: none"> ○ if statement ○ if else statement ○ switch statement • understand nested decision statements. • implement decision controls in Python program 	<ul style="list-style-type: none"> • Write a program using switch statement that asks the user for two numbers and the arithmetic operation (+,-,/,*) to perform on them and display result accordingly • Write a program to find the largest and smallest among three entered numbers and also display whether the identified largest/smallest number is even or odd. 		<ul style="list-style-type: none"> • Internet • Computer system • IDE for Python language 	
Loop	The students will be able to: <ul style="list-style-type: none"> • define concept of loop • describe FOR Loop in Python • describe WHILE Loop in Python • understand handling control variables for a loop • understand breaking a loop • implement loop in a Python program • understand nested loop 	<ul style="list-style-type: none"> • Write a program to generate first 10 multiples of any given number • Write a program to draw write angle triangle using asterisk (*) • Write a program to implement an arithmetic calculator using loop 	3 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for Python language 	Classroom and Lab
Arrays and lists	The students will be able to: <ul style="list-style-type: none"> • describe concepts of array • explain indexing and access of array • describe concepts of list • explain indexing and access of array • implementing arrays and lists in Python program 	<ul style="list-style-type: none"> • Write a program to store ten values from user in an array • Write a program to find a given integer value in an array already filled with integers • Write a program that takes name of the user and its marks for all Matric subjects and store it in a list and calculate their average 	3 Periods (T) 4 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for Python language 	Classroom and Lab
Built-in functions	The students will be able to: <ul style="list-style-type: none"> • describe built-in functions and its types • understand return types • understand parameters • usage of built-in function 	<ul style="list-style-type: none"> • Develop a program to solve quadratic equation based on input • Develop a program to calculate trigonometric identities for any given angle • Develop a program that finds the minimum and maximum value from a list using built-in-function 	2 Periods (T) 4 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • IDE for Python language 	Classroom and Lab
Chapter 02 (Operating system for IoT)					
T = 7, P = 6, Total = 11					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction to IoT OSs	The students will be able to: <ul style="list-style-type: none"> • describe IoT OS and its names 	<ul style="list-style-type: none"> • Presentation on characteristics of IoT OS 	3 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> • White board • Multimedia 	Classroom and Lab

	<ul style="list-style-type: none"> characteristics of IoT OS differentiate between conventional OS and IoT OS 	<ul style="list-style-type: none"> Group discussion on various IoT OS and their pros and cons for specific IoT applications 		<ul style="list-style-type: none"> Internet Computer system 	
Open system interconnection model (OSI) layered architecture	The students will be able to: <ul style="list-style-type: none"> define OSI architecture describe IoT application layer protocols (MQTT, CoAP) describe IoT transport layer protocols (DTLS) describe IoT network layer protocols (IPv6) describe IoT physical layer protocols (Wifi, Bluetooth, Zigbee) using MQTT broker and clients 	<ul style="list-style-type: none"> Discussion on differentiate between conventional protocol and IoT protocol Use open source MQTT client android app to send data to MQTT broker 	4 Periods (T) 4 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system Android mobile 	Classroom and Lab
Chapter 03 (Introduction to Database)					
T = 10, P = 13, Total = 23					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction	The students will be able to: <ul style="list-style-type: none"> describe the concept of data as info describe database importance of a database explain applications of database describe some known database systems 	<ul style="list-style-type: none"> Presentation on application of data base in real life 	2 Periods (T) 2 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system 	Classroom and Lab
Relational Database Management System (RDBMS)	The students will be able to: <ul style="list-style-type: none"> define RDBMS understand concept of table, rows and columns understand concept of entity and attributes. understand concept of relations and record. use entity relationship (ER) modeling to describe data describe schema understand concept of constraints <ul style="list-style-type: none"> primary key foreign key create schema 	<ul style="list-style-type: none"> Create a schema for a given problem containing minimum 4 entities using MS Office. 	4 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system MS office 	Classroom and Lab
Database (DB) installation	The Students will be able to: <ul style="list-style-type: none"> know the installation process of MySQL database Explain the usage of visual browser for MySQL 	<ul style="list-style-type: none"> Create a physical schema for a browser using visual browser 	2 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system 	Classroom and Lab

	<ul style="list-style-type: none"> understand the installation process of visual browser for MySQL create a physical schema using visual browser export/ Import schema using visual browser 			<ul style="list-style-type: none"> MySQL workbench, MySQL query browser MySQL database 	
Interaction with DB	The students will be able to: <ul style="list-style-type: none"> define query use Basic SQL queries in a database to: <ul style="list-style-type: none"> CREATE READ UPDATE 	<ul style="list-style-type: none"> Create a database for a small problem using SQL commands Insert few records to the database using SQL command Select and delete few records from the database using SQL command 	2 Periods (T) 5 Periods (P)	<ul style="list-style-type: none"> White board Multimedia Internet Computer system MySQL database MySQL workbench, MySQL query browser 	Classroom and Lab
Chapter 04 (IoT Cloud Deployment)					
T = 8, P = 14, Total = 19					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction to Cloud	The students will be able to: <ul style="list-style-type: none"> define cloud explain different types of cloud understand characteristics of cloud describe advantages and disadvantages of cloud 	<ul style="list-style-type: none"> Individual presentation on cloud services. 	2 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> Multi-media projectors Internet & web browser Computer-systems Cloud Provider 	Classroom & Lab
Cloud service providers	The students will be able to: <ul style="list-style-type: none"> define cloud service providers explain different types of cloud models describe usage of cloud service providers in cloud 	<ul style="list-style-type: none"> Group presentation on cloud service providers. Identify each application of the cloud in daily use. 	2 Periods (T) 3 Periods (P)	<ul style="list-style-type: none"> Multi-media projectors Internet & web browser Computer-systems Cloud Provider 	Classroom & Lab
Set up cloud server	The students will be able to: <ul style="list-style-type: none"> define cloud server understand the process to create an account and login on a cloud server provider's dashboard. know of virtualization and virtual machines. create a virtual machine. 	<ul style="list-style-type: none"> Create an account on online cloud service provider. Create a virtual machine and configure inbound and outbound rules. Install MQTT broker on the cloud and connect your local MQTT client with this broker 	4 Periods (T) 8 Periods (P)	<ul style="list-style-type: none"> Multi-media projectors Internet & web browser Computer-systems Cloud Provider 	Classroom & Lab

	<ul style="list-style-type: none"> understand of different configurations available on the dashboard install an OS on virtual machine. define inbound and outbound rules to open ports for SSH and FTP. 				
Chapter 05 (Basics of Data Science)					
T = 12, P = 19, Total = 31					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction to Data Science	The students will be able to: <ul style="list-style-type: none"> define data science understand the basic concepts, attributes, & features of data explain relationship between data science & IoT data preprocessing concept of: <ul style="list-style-type: none"> mean median mode standard deviation/variance 	<ul style="list-style-type: none"> Presentation on application of Data Sciences. Calculate Mean, Median, & Mode in MS Excel using iris or any other data set 	3 Periods (T) 5 Periods (P)	<ul style="list-style-type: none"> Multi-media projectors Internet & web browser Computer-systems MS Excel 	Classroom & Lab
Data Visualization	The students will be able to: <ul style="list-style-type: none"> define data visualization explain components of data visualization. understand of graphs and its types describe heat map identify trends in data know about tools available in Python to visualize different type of data process the import of CSV file in Python calculate mean, median, mode, standard deviation, variance 	<ul style="list-style-type: none"> Apply different data visualization techniques on iris or any other data set. Calculate mean, median, mode, standard deviation, & variance in Python 	3 Periods (T) 5 Periods (P)	<ul style="list-style-type: none"> Multi-media projectors Internet & web browser Computer-systems 	Classroom & Lab
Introduction of Machine Learning	The students will be able to: <ul style="list-style-type: none"> define machine learning define association rule and reinforcement learning explain types of regression & classification. define supervised and unsupervised learning 	<ul style="list-style-type: none"> Identify the regression and classification problem for a given use case Identify supervised and unsupervised problem for a given use space Apply KNN on a given data set in Python 	6 Periods (T) 9 Periods (P)	<ul style="list-style-type: none"> Multi-media projectors Internet & web browser Computer-systems 	Classroom & Lab

	<ul style="list-style-type: none"> understand training and testing of machine learning algorithm on a data set understand and apply K nearest neighbor (KNN) on a data set 				
Chapter 06 (IoT Security)					
T = 11, P = 17, Total = 28					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
IoT gateway protection	The students will be able to: <ul style="list-style-type: none"> define IoT Security describe threats to IoT describe security attacks on IoT, elaborate Wi-Fi attack. understand Wifi encryption. understand the concept of ACL/MAC filtering in Wi-Fi router. apply AES/TKIP on IoT gateway apply MAC address filtering 	<ul style="list-style-type: none"> Apply MAC filtering on Wi-Fi Router Apply AES on Wi-Fi Router/IoT gateway. 	4 Periods (T) 6 Periods (P)	<ul style="list-style-type: none"> Computer system Multimedia projector Wi-Fi router IoT network 	Class room and Lab
Device to device / end to end communication security	The students will be able to: <ul style="list-style-type: none"> know end to end communication. describe micro services. know and understand devices: <ul style="list-style-type: none"> users account, privileges setting, update firmware, describe isolation and its importance. understand ssl install ssl certificate on client understand physical security and techniques (deterrence, delay and detect) understand hashing and encryption. know about installing and using crypto module library. know about hashing function used in securing MQTT enlist security ambiguities in MQTT protocol enlist attacks and threat to MQTT protocol secure MQTT with encryption 	<ul style="list-style-type: none"> Create and delete a user account in any end devices. Update any end device firmware Isolate a IoT device from public network. Install a SSL certificate on client Implement physical security on nodes. Use MQTT on application layer Apply encryption on MQTT 	7 Periods (T) 11 Periods (P)	<ul style="list-style-type: none"> Computer system Multimedia projector Wi-Fi router IoT network 	Class room and Lab

Chapter 07 (Soft Skills)					
T = 9, P = 16, Total = 25					
Content	Students' Learning Outcome	Activities/Practical	Duration	Tools	Workplace
Introduction to soft skills	The students will be able to: <ul style="list-style-type: none"> know the basic soft skills understand the importance of soft skills in daily life apply soft skills for academic and professional success 	<ul style="list-style-type: none"> Group discussion and model presentation on soft skills 	02 Periods (T) 04 Periods (P)	<ul style="list-style-type: none"> Multimedia, projector or LED TV with good sound system 	Classroom
Communication Skills	The students will be able to: <ul style="list-style-type: none"> know model of communication. know importance of active listening and responding. understand effective communication. identify obstacles in communication. 	<ul style="list-style-type: none"> Perform role play and group exercises through listening audio or video documentaries. Carry out practice amongst students to reflect verbal and non-verbal communication. 	02 Periods (T) 03 Period (P)	<ul style="list-style-type: none"> Multimedia, projector or LED TV with good sound system 	Classroom
Leadership and teamwork	The students will be able to: <ul style="list-style-type: none"> know the importance of teamwork in a professional environment. understand the concept of teamwork and leadership. 	<ul style="list-style-type: none"> Give students some task to observe teamwork and leadership properties among them 	02 Periods (T) 03 Period (p)	<ul style="list-style-type: none"> Multimedia, projector or LED TV with good sound system 	Classroom
Time Management	The students will be able to: <ul style="list-style-type: none"> know the concept of better time management. observe time management in daily life understand professional and personal time management. 	<ul style="list-style-type: none"> Arrange a small competition task following time management and make a schedule the tasks. 	01 Periods (T) 03 Period (p)	<ul style="list-style-type: none"> Multimedia, projector or LED TV with good sound system 	Classroom/ Lab
Attitude, behavior, and customer care	The students will be able to: <ul style="list-style-type: none"> know the concepts of attitude and behavior understand the impact of positive and negative attitude in professional life 	<ul style="list-style-type: none"> Through different scenarios practically apply the principles of customer care and positive attitude. Exercise and deal with problematic and angry persons by conducting role plays 	02 Periods (T) 03 Periods (P)	<ul style="list-style-type: none"> Multimedia, projector, or LED TV with good sound system 	Classroom/ Lab

Assessment and Evaluation

Assessment is the practice of collecting evidence of student learning. It aims at improving learning and teaching as well as recognizing the achievement of students. It determines students' progression through their learning experiences and enables them to demonstrate that they have achieved the intended learning outcomes. The assessment is aligned with curriculum aims, design and learning processes.

Evaluation is an integral part of teaching-learning process. It involves gathering information through various assessment techniques, making valuable judgment and sound decisions. Assessment provides information and teaching about students' achievement in relation to learning objectives. With this information, the teacher makes informed decisions about what should be done to enhance the learning of students or to improve teaching methods. Assessment must be:

- Mainly open-ended, allowing for discussion and revision of new understanding.
- Tolerant of divergent thinking of students and promote the notion of no 'one right answer'.
- Presented in alternative mode, not just paper-and-pencil responses to limiting questions.
- Designed to foster analysis, comparison, generalization, prediction, and modification according to the grade and development level.
- Capable of promoting collaboration and team effort in demonstration of competence.
- Ongoing and cumulative, showing growth over time.

Formative (Internal) Assessment

Internal assessment refers to the assessment practices employed as part of the learning and teaching process. It is an ongoing process throughout the session and uses Test — Feedback — Adjust cycle repeatedly to improve students' performance and efficiency in learning and teaching. In designing internal assessment for the subject, teachers should maintain a proper balance between the formative and summative functions of assessment. It should be comprehensive to cover all the objectives as per curriculum. A diversity of assessment modes should be adopted so that students are given opportunities to develop and demonstrate the full range of learning outcomes of the curriculum, including those of knowledge, skills and values and attitudes.

Methods for Internal/Formative Assessment

Following tasks can help in formative assessment;

- Demonstration
- Practical exercises
- Group discussion
- Role play
- Oral/Multimedia presentation
- Test
- Assignment
- Quiz

Feedback on students work in all of the above tasks must be prompt, effective, and efficient. Assessment should have questions setting that specifically help in finding out knowledge, understanding and skills that can evaluate the competency of trainee.

Summative /External Assessment

Summative assessment will be managed by concerned Board of Intermediate and Secondary Education. It will be composed of two parts;

1) Theory Assessment /Written examination: The theory examination is suggested to consist of a wide variety of questions. Its overall weight age should be 40 %. It should be based on the curriculum rather than textbook. The assessment should be designed to examine the candidate's understanding of the whole syllabus and should test the range of abilities according to Bloom Taxonomy.

2) Practical Assessment/Practical examination: This is designed to test practical skills of students. Its overall weight age should be 60%. It will comprise of written exam (10%), practical (70 %) and viva/oral exam (20%).

A standards-referenced approach will be adopted for grading and reporting student performance. The purpose of this approach is to recognize what each student can do the in the subject at the end of the 2-year secondary school level education. The performance of each student will be matched against a set of performance standards, rather than comparing to the performance of other students. It makes the implicit standards explicit by providing specific indication of individual student performance. Descriptions will be provided for the set of standards.

Guidelines for Writing a Textbook

A textbook is an important teaching and learning resource and one of the most extensively used resources in classrooms. To reflect national needs and aspirations the needs and aspirations, the textbooks should be written in accordance with this curriculum. This curriculum meets not only the general aims and objectives but also fulfills the specific requirements of the individual subject. As the textbook serves as a framework for teaching, the author/authors should consider the following features:

- A textbook must include an introduction to the textbook, explaining how to use the textbook
- The textbook must be in line with the national curriculum, covering all SLOs of each content.
- Content and illustrations must be culturally, contextually and age appropriate.
- All text and material must be accurate, up-to-date and error-free.
- The continuity of the concepts, their integration and logical development should be ensured.
- Horizontal and vertical overlapping of the concepts should be avoided.
- The textbook should be informative and interactive with questions to be put at suitable intervals to provoke the students to think.
- The language used should be simple, clear, straight forward, unambiguous and easily comprehensible by the students of the particular level.
- Simple questions may be asked within the chapter, which requires students to recall, think, and apply what they have just learnt as well as to reinforce the learning of the concepts and principle.

- The examples and applications should be from everyday life and be supportive of our cultural values.
- Photographs and illustrations should be clear, labeled and supportive of the text. Tables, flow charts and graph may be given wherever needed.
- Key points at the end of each chapter should provide a summary of the important concepts and principles discussed in the chapter.
- End-of-the-chapter exercises must include a variety of assessment styles based on levels of Bloom's Taxonomy. These should encourage students to think, develop skills, and use information for a variety of purposes.
- Textbooks should be free from all kinds of biases including, gender, religion, occupation, social background etc.
- To make the students self-learner use of IT based resources may be encouraged. Relevant internet links and other online resources may be included.
- Glossary of the new vocabulary must be included.

Guideline for planning and writing a chapter

The textbook author may decide the titles of each chapter and can choose to cover students' learning outcomes (SLOs) from any themes in developing the content of the chapter. The textbook author must also keep in mind that a number of SLOs cannot be addressed in the text (as if this is done it would lead students to simply memorize the text and not serve the realization of the curriculum). These SLOs could be realized through questions and practical activities within and at the end of the chapter exercises.

- Learning outcomes must be given at beginning of each chapter.
- Decide on key ideas, facts, concepts, skills and values that can be developed.
- Illustrations must clearly convey the desired concept.
- Activities must demand from students to do inquiry and problem solving according to grade level.
- Ensure that the content is up to date, accurate and developmentally appropriate.
- Contents must be in line with chapter outcomes.
- Language must be consistent, culturally appropriate and grammatically correct (as if talking to a group).
- Language must engage and hold reader's attention.
- Recall previous learning, where possible.
- Structure the writing so that the sentence is simple, paragraphs deal with single ideas etc.
- Interesting information in the form of tidbits, fact file, point to ponder etc. must be given.
- Write a summary/concept map at end of each chapter, reviewing key knowledge and skills.
- End-of-chapter exercises
- Recall and integrate previous learning
- Engage students and develop their creativity
- Move from lower to higher order thinking
- Focus on multiple intelligences
- Keep the text contextually relevant in line with local teaching and learning.
- Provide website links for further research

Guidelines for Writing Learner Workbook

Workbooks are books that contain writing activities and exercises that build upon each chapter in the textbook. Workbook exercises help students to develop conceptual understanding of the concepts dealt with in the text, to develop skills and to apply knowledge to new situations. Basic features of a workbook A workbook should have:

- Various exercises and activities for each chapter, topic, subtopic.
- Exercises and activities that will enable student to develop and practice the content knowledge, skills and higher order thinking.
- Accurate and variety of exercises.
- Clear illustrations/ examples/ explanations to show what students are supposed to do, and/or what product looks like.
- Exercises and activities with a variety of purposeful, stimulating, challenging and innovative items to encourage students to review and practice the knowledge and skills they have learnt.
- Exercises that include both constructed and restricted response items.
- Activities, which requires readily available, acceptable, and affordable materials and resources.

Basic Requirements for Lab (Tools/Equipment)	
SR#	Tools & Equipment
1	Antivirus
2	Backup software
3	Cable connectors
4	Cable Tester
5	Computer Network
6	Computer system
7	Encryption software
8	Firewall software
9	Internet
11	Multimedia projector
12	Network
13	Network cable CAT5,CAT6
14	Networking Tools

15	Router
16	Switchers
17	Wifi router
18	Wireless router
19	Android mobile
20	Cloud Provider
21	Computer system
23	MS office
24	Multimedia, projector or LED TV with good sound system
25	Window image
26	Linux image
27	MySQL database
28	MySQL workbench, MySQL query browser
29	Python
30	White board
31	IoT network
32	IDE for C language
33	IDE for Python language
34	Cable puncher