1. The above table shows the equivalence between the modules of old syllabus and revised syllabus (Revision IV and V).
2. Candidates would not be allowed to appear in the equivalent papers of the Revision 5.1 (new syllabus), if they have already passed the relevant papers in earlier revision.
3. Candidates would have to pass a total of 4 papers (theory + practical's), successfully completed project in order to qualify 'O' Level in Revision 5.1 syllabus.
4. In case, the candidate has cleared examination as per Revision II and/or Revision III, the equivalency of Revision II with III and Revision III with IV will be done before the equivalency with Revision 5.1 is done.
5. Candidates would be allowed exemption in equal number of papers which they have passed in earlier syllabi prior to Revision 5.1.

15 Syllabus of Information Technology Tools and Network Basics (M1-R5.1)

15.1 Introduction

The module is designed to equip a student to use computers for professional as well as day to day use. It provides theoretical background as well as in-depth knowledge of Software/ packages.

15.2 Objectives

After completing the module, the incumbent will be able to:

- Acquire confidence in using computers in Office and General Life
- Identify the basic components of computers and terminology
- Understand file management
- Create documents using word processor, spreadsheet & presentation software
- Understand computer networks and browse the Internet, content search, email and collaborate with peers
- Use e-Governance applications and use computer to improve existing skills and learn new skills
- Understanding Social Networking platform
- Using the Internet for Digital Financial services
- Develop knowledge about FutureSkills
- Understand the various financial services and be aware of the various schemes started by Government.

15.3 Duration

120 Hours - (Theory: 48hrs + Practical: 72 hrs)

15.4 Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives

1. Introduction to Computer	4	6	After completion of this unit of module, the Learner will be able to • Identify computers, IT gadgets and explain their evolution and applications. • Get familiar with various input, output and hardware components of a computer along with storage devices. • Get familiar with various types of software, utilities used for computer and mobile apps.
2. Introduction to Operating System	4	6	After learning this unit, Learner will be: • Well acquainted with Operating System and its applications for both desktop and mobile devices. • Able to identify various desktop screen components and modify various properties, date, time etc. • Able to add and remove new program and features, manage files and folders. • Well versed with printing and know various types of file extensions.
3. Word Processing	6	9	After completion of this unit, Learner will have in depth knowledge of • Word Processing, their usage, details of word processing screen. • Opening, saving and printing a document including pdf files. • Document creation, formatting of text, paragraph and whole document. • Inserting Header and Footer on the document. • Finding text on a word document and correcting spellings.

			• Inserting and manipulating tables, enhancing table using borders and shading features. • Preparing copies of a document labels etc. for sending various recipients using Mail Merge.
4. Spreadsheet	8	12	After completion of this unit, Learner will have good hands-on practice on • Basic Knowledge of Spreadsheet Processing, their usage, details of Spreadsheet screen. • Opening, saving and printing a Spreadsheet. • Spreadsheet creation, inserting and editing data in cells, sorting and filtering of data. • Inserting and deleting rows /columns. • Applying basic formulas and functions. • Preparing chart to represent the information in a pictorial form.
5. Presentation	6	9	After completion of this unit, Learner will have good hands-on practice on • Basic Knowledge of presentations. • Opening/saving a presentation and printing of slides and handouts. • Manipulating slides to enhance the look of the slides as well as whole presentation by inserting a picture, objects, multimedia formatting etc. • Running a slide show with various transitions.
6. Introduction to Internet and WWW	6	9	After completion of this unit, Learner will be able to

			• Gather knowledge of various types of networks and topologies • Get an overview of the Internet, its applications and various browsers available to access the Internet. • Connect to the Internet using various modes of connections/devices available. • Get knowledge of device identification on local network as well as on the Internet for both Desktop and Mobile Devices. • Can search Information on the Internet on various topics. • Download and print web pages.
7. E-mail, Social Networking and e-Governance Services	6	9	After completion of this unit, Learner will be able to • Create an email account, compose an email, reply an email and send the email along with attachments • Get familiar with Social Networking, Instant Messaging and Blogs. • Get familiar with e-Governance Services, e-Commerce and Mobile Apps.
8. Digital Financial Tools and Applications	4	6	After completion of this unit, Learner will be able to • Know the Digital Financial Tools. • Get Knowledge of the Internet Banking Modes. • Use the Digital Locker and will be able to store documents in Digital Locker.
9. Overview of FutureSkills& Cyber Security	4	6	After completion of this unit, Learner will be familiar with the

			• Latest trends and technologies in upcoming fields in IECT. • Need of Cyber Security and will be able to secure their PC and Mobile devices by using basic security features.

15.5 Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to Computer, Introduction to Operating System	10
2. Word Processing	20
3. Spreadsheet	20
4. Presentation	20
5. Introduction to Internet and WWW, E-mail, Social Networking and e-Governance Services	20
6. Digital Financial Tools and Applications, Overview of FutureSkills& Cyber Security	10
7. Total	100

15.6 Detailed Syllabus

(i) Introduction to Computer

Computer and Latest IT gadgets, Evolution of Computers & its applications, IT gadgets and their applications, Basics of Hardware and Software, Central Processing Unit, Input devices, Output devices, Computer Memory & storage, Application Software, Systems Software, Utility Software, Open source and Proprietary Software, Mobile Apps.

(ii) Introduction to Operating System

Operating System, Basics of Operating System, Operating Systems for Desktop and Laptop, Operating Systems for Mobile Phone and Tablets, User Interface for Desktop and Laptop, Task Bar, Icons & shortcuts, running an application, Operating System simple setting, using mouse and changing its properties, changing system date and time, changing display properties, to add or remove Program and its features, adding, removing &sharing Printers, File and Folder management, types of file extensions.

(iii) Word Processing

Word Processing Basics, Opening Word Processing Package, Title Bar, Menu Bar, Toolbars & Sidebar, Creating a New Document, Opening and Closing Documents, Opening Documents, Save and Save As, Closing Document, Using The Help, Page Setup, Page Layout, Borders, Watermark, Print Preview, Printing of Documents, PDF file and Saving a Document as PDF file, Text Creation and manipulation, Document Creation, Editing Text, Text Selection, Cut, Copy and Paste, Font, Color, Style and Size selection, Alignment of Text, Undo & Redo, AutoCorrect, Spelling & Grammar,

Find and Replace, Formatting the Text, Creating and using user defined Styles, Paragraph Indentation, Bullets and Numbering, Change case, Header & Footer, Table Manipulation, Insert & Draw Table, Changing cell width and height, Alignment of Text in cell, Delete / Insertion of Row, Column and Merging & Splitting of Cells, Border and Shading, Mail Merge, Table of Contents, Indexes, Adding Comments, Tracking changes, Macros

(iv) Spreadsheet

Elements of Spread Sheet, Creating of Spread Sheet, Concept of Cell Address [Row and Column] and selecting a Cell, Entering Data [text, number, date] in Cells, Page Setup, Printing of Sheet, Saving Spreadsheet, Opening and Closing, Manipulation of Cells & Sheet, Modifying / Editing Cell Content , Formatting Cell (Font, Alignment, Style), Cut, Copy, Paste & Paste Special, Changing Cell Height and Width, Inserting and Deleting Rows, Column, AutoFill, Sorting & Filtering, Freezing panes, Formulas, Functions and Charts, Using Formulas for Numbers (Addition, Subtraction, Multiplication & Division), AutoSum, Functions (Sum, Count, MAX, MIN, AVERAGE),Sort, Filter, Advanced Filter, Database Functions (DSUM, DMIN,DMAX, DCOUNT, DCOUNTA), What-if Analysis, Pivot table Charts (Bar, Column, Pie, Line), Data Validation.

(v) Presentation

Creation of Presentation, Creating a Presentation Using a Template, Creating a Blank Presentation, Inserting & Editing Text on Slides, Inserting and Deleting Slides in a Presentation, Saving a Presentation, Manipulating Slides, Inserting Table , Adding Pictures, Inserting Other Objects, Resizing and Scaling an Object, Creating & using Master Slide, Presentation of Slides , Choosing a Set Up for Presentation, Running a Slide Show, Transition and Slide Timings, Automating a Slide Show, Providing Aesthetics to Slides & Printing, Enhancing Text Presentation, Working with Color and Line Style, Adding Movie and Sound, Adding Headers, Footers and Notes, Printing Slides and Handouts

(vi) Introduction to Internet and WWW

Basic of Computer Networks, Local Area Network (LAN), Wide Area Network (WAN), Network Topology , Internet, Concept of Internet & WWW, Applications of Internet, Website Address and URL, Introduction to IP Address, ISP and Role of ISP, Internet Protocol, Modes of Connecting Internet (HotSpot, Wifi, LAN Cable, BroadBand, USB Tethering), Identifying and uses of IP/MAC/IMEI of various devices, Popular Web Browsers (Internet Explorer/Edge, Chrome, Mozilla Firefox, Opera etc.), Exploring the Internet , Surfing the web, Popular Search Engines, Searching on Internet, Downloading Web Pages, Printing Web Pages

(vii) E-mail, Social Networking and e-Governance Services

Structure of E-mail, Using E-mails, Opening Email account, Mailbox: Inbox and Outbox, Creating and Sending a new E-mail, Replying to an E-mail message, Forwarding an E-mail message, Searching emails, Attaching files with email, Email Signature, Social Networking & e-Commerce, Facebook, Twitter, Linkedin, Instagram, Instant Messaging (Whatsapp, Facebook Messenger, Telegram), Introduction to Blogs, Basics of E-commerce, Netiquettes, Overview of e-Governance

Services like Railway Reservation, Passport, eHospital [ORS], Accessing e-Governance Services on Mobile Using "UMANG APP", Digital Locker

(viii) Digital Financial Tools and Applications

Digital Financial Tools, Understanding OTP [One Time Password]and QR [Quick Response] Code, UPI [Unified Payment Interface], AEPS [Aadhaar Enabled Payment System], USSD [Unstructured Supplementary Service Data], Card [Credit / Debit], eWallet, PoS [Point of Sale], Internet Banking, National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Online Bill Payment

(ix) Overview of Futureskills and Cyber Security

Introduction to Internet of Things (IoT), Big Data Analytics, Cloud Computing, Virtual Reality, Artificial Intelligence, Social & Mobile, Blockchain Technology, 3D Printing/ Additive Manufacturing, Robotics Process Automation, Cyber Security, Need of Cyber Security, Securing PC, Securing Smart Phone

15.7 Reference Books/Study Material

1. LibreOffce, Getting Started Guide by LibreOffice Documentation Team
2. Computer Networking by EdTittel,McGRaw Hills Companies
3. OpenOffice.org for DUMMIES by GurdyLeete, Ellen Finkelstein and Mary Leete

16 Syllabus of Web Designing and Publishing (M2-R5.1)

16.1 Introduction to Module

This module is designed to start web designing, irrespective of knowledge currently the students have in this area. The businesses, nowadays, are heavily relying on web based applications. The purpose of this module is to provide skill to students in designing layouts of web sites. By the end of this module, students will be able to describe the structure and functionality of the World Wide Web, create web pages using a combination of HTML, CSS, and JavaScript and Angular JS. The students will also learn how to design and integrate multimedia objects in web site. Further, the student will learn how web sites are published.

16.2 Objective

After completing the module, the student will be able to:

- Design and create effective web pages
- Integrate graphics in web pages
- Integrate various tools and techniques like HTML, CSS, JavaScript, Angular JS etc.
- Design and edit images using tools
- Embed the images in web pages

16.3 Duration

120 Hours - (Theory: 48hrs + Practical: 72 hrs)

16.4 Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
Introduction to Web Design	2	3	After completing this unit, Learner will be able to • Know the types of web site. • Know the role of front end and back end application. • Understand the concept of client side scripting and server side scripting
Editors	2	3	After completing this unit, learner will be able to • Use different editors available for writing code. • Understand working of editors.
HTML Basics	10	15	After completing this unit, Learner will be able to develop static website using different HTML Controls.
Cascading Style Sheets (CSS)	10	15	After completing this unit, Learner will be able to understand the • Purpose of CSS. • Role of CSS in web sites. • Roles of effects in Web site.
CSS Framework	6	9	After completing this unit, Learner will be able to use CSS Framework to develop web site effectively.
JavaScript and Angular JS	10	15	After completing this unit, Learner will be able to • Apply client side scripting. • Adding validations and checks on forms (web pages).
Photo Editor	6	9	After completing this unit, Learner will be able to edit

			images and embed in web pages.
Web Publishing and Browsing	2	3	The Learner will finally be able to publish the web sites.

16.5 Marks Distribution

Module Unit	Written Marks (Max.)
1 Introduction to Web Design and Editors, HTML Basics	25
2 Cascading Style Sheets (CSS)	20
3 CSS Framework	15
4 JavaScript and Angular Js	20
5 Photo Editor, Web Publishing and Browsing	20
6 Total	100

16.6 Detailed Syllabus

(i) Introduction to Web Design

Introduction of Internet, WWW, Website, Working of Websites, Webpages, Front End, Back End, Client and Server Scripting Languages, Responsive Web Designing, Types of Websites (Static and Dynamic Websites).

(ii) Editors

Downloading free Editors like Notepad++, Sublime Text Editor, making use of Editors, File creation and editing, saving.

(iii)HTML Basics

HTML: Introduction, Basic Structure of HTML, Head Section and Elements of Head Section, Formatting Tags: Bold, Italic, Underline, Strikethrough, Div,Pre Tag Anchor links and Named Anchors Image Tag, Paragraphs, Comments, Tables: Attributes – (Border, Cellpadding, Cellspacing , height , width), TR, TH, TD, Rowspan, Colspan Lists : Ordered List , Unordered List , Definition List, Forms, Form Elements, Input types, Input Attributes, Text Input Text Area, Dropdown, Radio buttons , Check boxes, Submit and Reset Buttons Frames: Frameset, nested Frames.
HTML 5 Introduction, HTML5 New Elements: Section, Nav, Article, Aside, Audio Tag, Video Tag, HTML5 Form Validations: Require Attribute, Pattern Attribute, Autofocus Attribute, email, number type, date type, Range type, HTML embed multimedia, HTML Layout, HTML Iframe

(iv)CSS

Introduction to CSS, Types of CSS, CSS Selectors: Universal Selector, ID selector, Tag Selector, Class Selector, Sub Selector, Attribute Selector, Group Selector, CSS Properties: Back Ground properties, Block Properties, Box properties, List properties, Border Properties, Positioning Properties, CSS Lists CSS Tables, CSS Menu Design CSS Image Gallery,

(v) CSS Framework

Web Site Development using W3.CSS Framework, W3.CSS Intro, W3.CSS Colors, W3.CSS Containers, W3.CSS Panels, W3. CSS Borders, W3.CSS Fonts, W3.CSS Text, W3.CSS Tables, W3.CSS List, W3.CSS Images, W3.CSS Grid

(vi) JavaScript and Angular JS

Introduction to Client Side Scripting Language, Variables in Java Script, Operators in JS, Conditions Statements, JS Popup Boxes, JS Events, Basic Form Validations in JavaScript. Introduction to Angular JS: Expressions, Modules and Directives.

(vii) Photo Editor

Features of Photo Editing: Tools: Selection Tools, Paint Tools, Transform Tools, Text Tool, Layers, Brightness/ Contrast, Improve Colors and tone, Filters.

(viii) Web Publishing and Browsing

Overview, SGML (Standard Generalized Markup Language), Web hosting Basics, Documents Interchange Standards, Components of Web Publishing, Document management, Web Page Design Considerations and Principles, Search and Meta Search Engines, WWW, Browser, HTTP, Publishing Tools.

16.7 Reference Books/Study Material

1. HTML5, Black Book, Kagent Learning Solution Inc, 2014
2. Mastering HTML, CSS &JavaScript Web Publishing by Lemay Laura, BPB publications
3. HTML & CSS: The Complete Reference by Thomas Powell
4. Web Design, McGraw –hill
5. Learning Angular JS by Brad Dayley, Pearson

17 Syllabus of Programming and Problem Solving Through Python Language (M3-R5.1)

17.1 Introduction to Module

Python is easy to use, powerful and versatile programming language, making it a great choice for developers. Python is used widely in different areas likes building Raspberry Pi applications, writing script program for desktop applications, configuring servers, developing machine learning& data analytics applications and developing web applications.

17.2 Objectives

The objectives of this module are to make the learners understand the programming language concepts like Data Types, Loops, Functions; Python Lists, Strings, Tuples, Dictionaries, Elementary Data Handling using Pandas, NumPy etc.

After completion of this course, the learner is expected to analyze the real life problem and write a program in Python to solve the problem. The main emphasis of the module will be on writing algorithm to solve problems and implement in Python. After completion of the module, the learner will be able to

- Draw flow charts for solving different problems
- Develop efficient algorithms for solving a problem
- Use the various constructs of Python viz. conditional, iteration
- Write programs making judicious use of Lists, Strings, Tuples, Dictionaries wherever required
- Manage data using NumPy
- Handle files and create Modules in Python

17.3 Duration

120 Hours - (Theory: 48hrs + Practical: 72 hrs)

17.4 Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to Programming	2	3	After completion of this unit of module, Learner will be able to • Understand the concept of Programming. • Understand evolution of Programming.
2. Algorithm and Flowcharts to solve problems	6	9	After completion of this unit of module, Learner will be able to • Understand the concepts and purposes of algorithm and flowchart. • Use algorithm and flowchart to solve problem independent of language. • Gain knowledge of different constructs of algorithm and flowchart.
3. Introduction to Python	2	3	After completion of this unit of module, candidate will be able to • Understand features of Python that make it one the most popular languages in the industry. • Understand structure of Python problem. • Understand the areas where Python is used.
4. Operators, Expressions and	10	15	After completion of this unit of module, Learner will be able to

Python Statements			• Use the basic operators and expressions available in Python in developing program. • Understand and use various Python statements like conditional constructs, looping constructs in writing Python program.
5. Sequence data types	6	9	After completion of this unit of module, Learner will be able to • Work with various built-in Sequence datatypes and their use • Understand the concept of mutable and immutable objects
6. Functions	10	15	After completion of this unit of module, Learner will be able to • Apply the in-built functions available in Python in solving different problems. • Work with modular approach using user defined functions.
7. File Processing	6	9	After completion of this unit of module, Learner will be able to work with files and reading /writing onto files.
8. Modules	2	3	After completion of this unit of module, Learner will be able to • Understand the concept of modules and importing, loading and reloading of modules in programs.
9. NumPy Basics	4	6	After completion of this unit of module, Learner will be able to • Work on NumPy array manipulation to access data and subarrays and to split, reshape, join arrays etc
Total	48	72	

17.5 Marks Distribution

Module Unit	**Written Marks (Max.)**
1. Introduction to Programming, Algorithm and Flowcharts to solve problems	20
2. Introduction to Python, Operators, Expressions and Python Statements, Sequence data types	30
3. Functions, File Processing, Modules	40

4. NumPy Basics	10
5. Total	100

17.6 Detailed Syllabus

(i) Introduction to Programming

The basic Model of computation, algorithms, flowcharts, Programming Languages, compilation, testing & debugging and documentation.

(ii) Algorithms and Flowcharts to Solve Problems

Flow Chart Symbols, Basic algorithms/flowcharts for sequential processing, decision based processing and iterative processing. Some examples like: Exchanging values of two variables, summation of a set of numbers, Decimal Base to Binary Base conversion, reversing digits of an integer, GCD (Greatest Common Divisor) of two numbers, Test whether a number is prime, factorial computation, Fibonacci sequence, evaluate 'sin x' as sum of a series, Reverse order of elements of an array, Find largest number in an array, Print elements of upper triangular matrix, etc.

(iii) Introduction to Python

Python Introduction, Technical Strength of Python, Introduction to Python Interpreter and program execution, Using Comments, Literals, Constants, Python's Built-in Data types, Numbers (Integers, Floats, Complex Numbers, Real, Sets), Strings (Slicing, Indexing, Concatenation, other operations on Strings), Accepting input from Console, printing statements, Simple 'Python' programs.

(iv) Operators, Expressions and Python Statements

Assignment statement, expressions, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Conditional statements: if, if-else, if-elif-else; simple programs, Notion of iterative computation and control flow –range function, While Statement, For loop, break statement, Continue Statement, Pass statement, else, assert.

(v) Sequence Data Types

Lists, tuples and dictionary, (Slicing, Indexing, Concatenation, other operations on Sequence datatype),concept of mutability, Examples to include finding the maximum, minimum, mean; linear search on list/tuple of numbers, and counting the frequency of elements in a list using a dictionary.

(vi) Functions

Top-down approach of problem solving, Modular programming and functions, Function parameters, Local variables, the Return statement, Doc Strings, global statement, Default argument values, keyword arguments, VarArgs parameters.

Library function-input(), eval(),print(), String Functions: count(), find(), rfind(), capitalize(), title(), lower(), upper(), swapcase(), islower(), isupper(), istitle(), replace(), strip(), lstrip(), rstrip(), aplit(), partition(), join(), isspace(), isalpha(), isdigit(), isalnum(), startswith(), endswith(), encode(), decode(), String: Slicing, Membership, Pattern

Matching, Numeric Functions: eval(), max(), min(), pow(), round(), int(), random(), ceil(), floor(), sqrt(), Date & Time Functions, Recursion.

(vii) File Processing

Concept of Files, File opening in various modes and closing of a file, Reading from a file, Writing onto a file, File functions-open (), close (), read (), readline(), readlines(), write(), writelines(),tell(),seek(), Command Line arguments.

(viii) Scope and Modules

Scope of objects and Names, LEGB Rule
Module Basics, Module Files as Namespaces, Import Model, Reloading Modules.

(ix) NumPy Basics

Introduction to NumPy ndarray, datatypes, array attributes, array creation routines, Array From Existing Data, Array From Numerical Ranges, Indexing & Slicing.

17.7 Reference Books/Study Material

1. Python Programming- A Modular Approach (with Graphics, database, Mobile and Web Applications by Sheetal Taneja and Naveen Kumar, Pearson.
2. Python Network Programming Cookbook by Pradeeban Kathiravelu, Dr. M. O. Faruque Sarkar, PACKT.
3. Head First Python by Paul Berry, O'Reilly
4. Dive into Python by Mark Pilgrim, APress
5. Beginning Programming with Python Dummies by John Paul Meuller.

18 Syllabus of Internet of Things and its Applications (M4-R5.1)

18.1 Introduction

The module is designed to equip the students to understand the basics of connected world that is Internet of Things (IoT) and its applications. IoT primarily refers to the connected

and smarter world having physical and virtual objects with some unique identities. IoT applications span across domains of industrial control, retail, energy, agriculture, etc.

This module provides the theoretical and practical aspects of interfacing sensors and actuators, making informed world of Things speaking to each other. The different type of communication modes and models are discussed in detail. The in-depth knowledge of software and packages is provided to make applications in IoT paradigm.

18.2 Objective

After completing the module, the learner will be able to:

- Understand how connected devices work together to update other applications.
- Acquire knowledge to interface sensors and actuators with microcontroller based Arduino platform.
- Writing C programs in Arduino IDE.
- Understand the Communication between microcontroller and PC using serial communication.
- Build IoT based applications and understand how data flows between things.
- Understand how electronic devices control electrical appliances working at 220v AC.
- Understand security aspect of IoT devices.
- Enhance skill set towards better personality development.

18.3 Duration

120 Hours - (Theory: 48hrs + Practical: 72 hrs)

18.4 Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to IoT – Applications/ Devices, Protocols andCommunication Model	4	6	After completion of this unit of module, Learner will be able to • Understand various IoT Applications, protocols, architecture, etc. • Understand the characteristics of IoT devices. • Know about Physical Design/Logical Design, Functional blocks of IoT and Communication Models.

2. Things and Connections	4	6	After completing this unit, Learner will be able to understand • Closed loop/ feedback loop system. • The use of sensors, actuators and controllers in the IoT process flow. • TCP/IP Versus OSI models. • Wired and wireless connectivity.
3. Sensors, Actuators and Microcontrollers	8	12	After completing this unit, Learner will be able to understand • The role of Sensors, transducers in measuring physical quantities. • Working and characteristics of actuators. • Role and use of microcontroller in building various electronic devices.
4. Building IoT Applications	20	30	After completing this unit, Learner will be able to understand • Working of microcontroller and hardware prototyping Arduino platform. • The role of 'C' language in building IoT applications. • Built-in Data-type, operators-expressions • Conditional statements and loops. • Arrays, functions. • Digital, analog pins of Arduino. • Interfacing sensors, actuator. • Using ArduBlock GUI tool.
5. Security and Future of IoT Ecosystem	4	6	After completing this unit, Learner will be able to understand • Need of security in IoT. • Various basic concept of security. • Security levels. • Need of powerful CPU for Future IoT eco system.
6. Soft skills-Personality Development	8	12	After completing this unit, Learner will be able to understand • Role of positive personality and determinants of personality. • Self-esteem. • Communication and writing skills.

18.5 Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to IoT – Applications/Devices, Protocols and Communication Model	10
2. Things and Connections	10
3. Sensors, Actuators and Microcontrollers	15
4. Building IoT Applications	40
5. Security and Future of IoT Ecosystem	5
6. Soft skills-Personality Development	20
Total	100

18.6 Detailed Syllabus

(i) Introduction to Internet of Things – Applications/Devices, Protocols andCommunication Model

Introduction - Overview of Internet of Things(IoT), the characteristics of devices and applications in IoT ecosystem, building blocks of IoT, Various technologies making up IoT ecosystem, IoT levels, IoT design methodology, The Physical Design/Logical Design of IoT, Functional blocks of IoT and Communication Models, Development Tools used in IoT.

(ii) Things and Connections

Working of Controlled Systems, Real-time systems with feedback loop e.g. thermostat in refrigrator, AC, etc.Connectivity models – TCP/IP versus OSI model, different type of modes using wired and wireless methodology, The process flow of an IoT application.

(iii)Sensors, Actuators and Microcontrollers

Sensor - Measuring physical quantities in digital world e.g. light sensor, moisture sensor, temperature sensor, etc.

Actuator – moving or controlling system e.g. DC motor, different type of actuators

Controller – Role of microcontroller as gateway to interfacing sensors and actuators, microcontroller vs microprocessor, different type of microcontrollers in embedded ecosystem.

(iv)Building IoT applications

Introduction to Arduino IDE – writing code in sketch, compiling-debugging, uploading the file to Arduino board, role of serial monitor.

Embedded ‘C’ Language basics - Variables and Identifiers, Built-in Data Types, Arithmetic operators and Expressions, Constants and Literals, assignment.

Conditional Statements and Loops - Decision making using Relational Operators, Logical Connectives - conditions, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement.

Arrays – Declaring and manipulating single dimension arrays
Functions - Standard Library of C functions in Arduino IDE, Prototype of a function: Formal parameter list, Return Type, Function call.

Interfacing sensors – The working of digital versus analog pins in Arduino platform, interfacing LED, Button, Sensors-DHT, LDR, MQ135, IR. Display the data on Liquid Crystal Display(LCD), interfacing keypad

Serial communication – interfacing HC-05(Bluetooth module)
Control/handle 220V AC supply – interfacing relay module.

(v) Security and Future of IoT Ecosystem

Need of security in IoT - Why Security? Privacy for IoT enabled devices- IoT security for consumer devices- Security levels, protecting IoT devices

Future IoT eco system - Need of power full core for building secure algorithms, Examples for new trends - AI, ML penetration to IoT

(vi) Soft skills-Personality Development

Personality Development - Determinants of Personality- self-awareness, motivation, self-discipline, etc., building a positive personality, gestures.

Self-esteem - self-efficacy, self-motivation, time management, stress management, Etiquettes & manners.

Communication and writing skills- objective, attributes and categories of communication, Writing Skills – Resume, Letters, Report, Presentation, etc. Interview skills and body language.

18.7 Use-case for building IoT based Applications

A. Using Arduino and sensors/actuators

i. Interfacing Light Emitting Diode(LED)- Blinking LED:
This use case will be used for familiarizing the GPIO peripheral of atmega micro controller. The LED will be used as a device and GPIO will work as output mode.

ii. Interfacing Button and LED – LED blinking/glow when button is pressed
This use case will help to understand the GPIO in two different modes, Input - Button and LED - output mode.

iii. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
This use case will help to understand ADC peripheral and how to read analog data from sensors.

iv. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)

This use case will help to connect traditional environmental monitoring sensors (Temperature and humidity) to the Arduino development board. Also use the suitable libraries for implementing these case studies.

v. Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD
This case study will demonstrate how to provide local display unit with Arduino micro controller. Use suitable libraries for implementing these case studies.

vi. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD, switch on LED when data sensed is higher than specified value.
This use case will help to understand how to use traditional smart pollution management sensors with Arduino platform for developing applications as a part of smart city projects.

vii. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
This use case will help to understand the connectivity solution to Arduino to a gadget like mobile phone. Bluetooth is used as connectivity solution in this application.

viii. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
This use case will enable the IoT node capability of Arduino development boards by integrating actuator (relay connected to GPIO) to Arduino board and remote connectivity (Using Bluetooth) using a mobile phone with the help of a readily available Bluetooth serial application.

18.8 Reference Books/Study Material

1. Macro Schwartz, “Internet of Things with Arduino- Cookbook”, Packt 2016
2. Arshdeep Bajga and Vijay Madisetti, “Internet of Things- A Hands-on Approach” Universities Press, 2014
3. Massimo Banzi, “Getting started with Arduino”, 2nd Edition, Oreilly, 2011 [Make:Makezine.com]
4. Macro Schwartz, “Internet of Things with Arduino”, Open Home Automation
5. Michael Margolis, “Arduino Cookbook”, Oreilly, 2011