MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. Minor in Internet of Things
Scheme of Instruction and Examination
Applicable for the batches admitted in the academic year 2021-22

(MR21 - Regulations)

S.No	Year/Semester	Course Code	Course Title	Instruction Hours PerWeek			Credits
				L	T	P	
1	V - Semester	M155AD	Python Programming	3	0	0	3
2	V - Semester	M15504	Python Programming Laboratory	0	0	3	1.5
3	VI - Semester	M156AD	Introduction to IoT	3	0	0	3
4	VI - Semester	M156AE	Smart Technologies	3	0	0	3
5	VII - Semester	M157AG	Programming Languages for IoT	3	0	0	3
6	VII - Semester	M15707	IoT Automation with Raspberry-PI Laboratory	0	0	3	1.5
7	VIII - Semester	M158AT	Fog & Edge Computing for IoT	3	0	0	3
Total Credits							**18**

L: Lecture   **T**: Tutorial **P**: Practical

B.Tech. Internet of Things (Minor) V Semester   L   T   P   C
                                                           3   0   0   3

M155AD: PYTHON PROGRAMMING

Course Objectives: This course will enable students to
1. Learn Syntax and Semantics and create Functions in Python.
2. Handle Strings and Files in Python.
3. Understand Lists, Dictionaries and Regular expressions in Python.
4. Implement Object Oriented Programming concepts in Python.
5. Build Web Services and introduction to Network and Database Programming in Python.

Course Outcomes: The students should be able to:
1. Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Implement exemplary applications related to Network Programming, Web Services and
6. Databases in Python.

UNIT - I
Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types
Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Built-in Functions, Related Modules Sequences - Strings, Lists, and Tuples, Mapping and Set Types

UNIT - II
FILES: File Objects, File Built-in Function [open()], File Built-in Methods, File Built-in Attributes, Standard Files, Command- line Arguments, File System, File Execution, Persistent Storage Modules, Related Modules
Exceptions: Exceptions in Python, Detecting and Handling Exceptions, Context Management, *Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions, *Creating Exceptions, Why Exceptions (Now)?, Why Exceptions at All?, Exceptions and the sys Module, Related Modules
Modules: Modules and Files, Namespaces, Importing Modules, Importing Module Attributes, Module Built-in Functions, Packages, Other Features of Modules

UNIT - III
Regular Expressions: Introduction, Special Symbols and Characters, Res and Python Multithreaded Programming: Introduction, Threads and Processes, Python, Threads, and the Global Interpreter Lock, Thread Module, Threading Module, Related Modules

UNIT - IV
GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs WEB Programming: Introduction, Wed Surfing with Python, Creating Simple Web Clients, Advanced Web Clients, CGI-Helping Servers Process Client Data, Building CGI Application Advanced CGI, Web (HTTP) Servers

UNIT – V
Database Programming: Introduction, Python Database Application Programmer's Interface (DB-API), Object Relational Managers (ORMs), Related Modules

Textbook
1. Core Python Programming, Wesley J. Chun, Second Edition, Pearson.

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                                                       0   0   3   1.5
M15504: PYTHON PROGRAMMING LAB

Prerequisites: Students should install Python on Linux platform.

Course Objectives:
1. To be able to introduce core programming basics and program design with functions using Python programming language.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand the high-performance programs designed to strengthen the practical expertise.

Course Outcomes:
1. Student should be able to understand the basic concepts scripting and the contributions of scripting language
2. Ability to explore python especially the object oriented concepts, and the built in objects of Python.
3. Ability to create practical and contemporary applications such as TCP/IP network programming, Web applications, discrete event simulations

List of Programs:
1. Write a program to demonstrate different number data types in Python.
2. Write a program to perform different Arithmetic Operations on numbers in Python.
3. Write a program to create, concatenate and print a string and accessing sub-string from a given string.
4. Write a python script to print the current date in the following format "Sun May 29 02:26:23 IST 2017"
5. Write a program to create, append, and remove lists in python.
6. Write a program to demonstrate working with tuples in python.
7. Write a program to demonstrate working with dictionaries in python.
8. Write a python program to find largest of three numbers.
9. Write a Python program to convert temperatures to and from Celsius, Fahrenheit.
    a. [Formula: c/5 = f-32/9]
10. Write a Python program to construct the following pattern, using a nested for loop
    ```
    *
     * *
     * * *
     * * * *
     * * * * *
     * * * *
     * * *
     * *
     *
    ```
11. Write a Python script that prints prime numbers less than 20.
12. Write a python program to find factorial of a number using Recursion.

13. Write a program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle (Recall from the Pythagorean Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides).

14. Write a python program to define a module to find Fibonacci Numbers and import the module to another program.

15. Write a python program to define a module and import a specific function in that module to another program.

16. Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.

17. Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.

18. Write a Python class to convert an integer to a roman numeral.

19. Write a Python class to implement pow(x, n)

20. Write a Python class to reverse a string word by word.

B.Tech. Internet of Things (Minor) VI Semester   **L   T   P   C**
                                                            3   0   0   3

M156AD: INTRODUCTION TO INTERNET OF THINGS

1. To introduce Terminology, Technology and its applications
2. To introduce the Raspberry PI platform, that is widely used in IoT applications
3. To introduce the implementation of web-based services on IoT devices Course Outcomes, Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved
4. Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules

UNIT-I: Introduction to Internet of Things
Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNIT-II: IoT and M2M- Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT-III: IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

UNIT-IV: Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor

UNIT-V: IoT Physical Servers and Cloud Offerings– Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

TEXT BOOKS:
1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9889350239759 3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895 REFERENCE BOOKS: 1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Editors Ovidiu Vermesan 2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014 3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

B.Tech. Internet of Things (Minor) VI Semester	L	T	P	C
	3	0	0	3

M156AE: SMART TECHNOLOGIES

Course Objectives:
1. Provides a detailed description of the integral aspects of 'smart technologies' and their evolution to their current state.
2. Discusses the potential use of Internet of things (IoT) in reducing counterproductive work behaviours and identifying some of the challenges that organizations might face while implementing IoT in its systems.
3. Presents case studies using easy-to-understand language to explain the breadth and scope of application areas.

UNIT - I
Smart Technologies - Scope and Applications, Cutting-Edge Digitization Challenges in Vehicle Cyber- Physical Systems and Cybersecurity, Big Data Analytics as an Enabler in Smart Governance for the Future Smart Cities

UNIT - II
Digital Masters: Blueprinting Digital Transformation, UAVs/Drones-Based IoT Services, Role of Cyber Security in Drone Technology

UNIT - III
Bitcoins as an Implementation of Block chain and Its Convergence with Internet of Things, Tomorrow's AI-Enabled Banking, Exploring Connected Cars

UNIT - IV
Vehicular Cybersecurity Through Intrusion Detection and Prevention Architecture, Mechanism Protecting Vehicle-to-Vehicle Communication, Advanced Driver Assistance Systems

UNIT - V
Cybercare—Role of Cyber Security in Healthcare Industry, Smart Agriculture: A Tango Between Modern IoT-Based Technologies and Traditional Agriculture Techniques, Importance of Being 'NICE' While Developing IoT-Based Smart Farming Solutions: A Case Study About 'NICE' Labs

TEXT BOOK:
1. Smart Technologies-Scope and Applications by K. B. Akhilesh, Dietmar P. F. Möller, Springer publications, 2020

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                                                             3   0   0   3

M157AG: PROGRAMMING LANGUAGES FOR IOT

1. This program aims to train students to be equipped with a solid theoretical foundation, systematic professional knowledge and strong practical skills in the Raspberry Pi.
2. The course focuses on higher-level operating systems, advanced networking, user interfaces, multimedia and uses more computing intensive IoT applications as examples using Raspberry Pi running Linux as the platform of choice

Course Outcomes:

1. Appreciate the development technology for IoT
2. Familiar with Basic Concepts of Linux
3. Design real time IoT Devices and Familiar with basic foundations of Python Programming and libraries
4. Comprehend the basic concepts of Mobile Cloud Computing

UNIT - I

Getting Started with Raspberry Pi: Basic functionality of Raspberry Pi B+ board, setting up the board, configuration and use, implications of an operating system on the behavior of the Raspberry Pi as an IoT device, booting Raspberry Pi 3, Downloading an Operating System, format an SD card and booting the OS, Basics of Linux and its use, main features including navigating the file system and managing processes, text based user interface through the shell, overview of the graphic user interface for Raspian Linux distribution.

UNIT - II

Interfacing Hardware with the Raspberry Pi, Raspberry Pi Remote Access, operates the Raspberry Pi in "headless mode", Bash Command line, operating Raspberry Pi without needing a GUI interface. Basics of the Python programming language, programming on the Raspberry Pi. Python on Raspberry Pi, Python Programming Environment, Python Expressions, Strings, Functions and Function arguments, Lists, List Methods, Control Flow.

UNIT - III

Communication with devices through the pins of the Raspberry Pi, RPi.GPIO library, Python Functions, setting up the pins, General purpose IO Pins, Protocol Pins, GPIO Access, applying digital voltages, and generating Pulse Width Modulated signals, Tkinter Python library, accessing pins through a graphic user interface

UNIT - IV

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs. Web Server – Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful web API. Connecting to APIs

UNIT - V

IoT Design using Raspberry Pi IoT Applications based on Pi, LAMP Web-server, GPIO Control over Web Browser, Creating Custom Web Page for LAMP, Communicating data using on-board module, Home automation using Pi, Node-RED, MQTT Protocol, Using Node-RED Visual Editor on Rpi

TEXT BOOKS:
1. Simon Monk, "Programming the Raspberry Pi: Getting Started with Python", January 2012, McGraw Hill Professional.
2. Raspberry Pi with Java: Programming the Internet of Things (IoT) (Oracle Press) 1st Edition.
3. The official raspberry Pi Projects Book,
   https://www.raspberrypi.org/magpiissues/Projects_Book_v1.pdf

REFERENCE BOOKS:
1. Eben Upton and Gareth Halfacree, "Raspberry Pi User Guide", August 2016, 4th edition, John Wiley & Sons.
2. Alex Bradbury and Ben Everard, "Learning Python with Raspberry Pi", Feb 2014, JohnWiley & Sons.
3. Michael Margolis, "Arduino Cookbook", First Edition, March 2011, O'Reilly Media, Inc.

B.Tech. Internet of Things (Minor) VII Semester   L   T   P   C
                                                            0   0   3   1.5

M15707: IOT AUTOMATION WITH RASPBERRY PI LAB

Course Objectives:

1. To introduce the raspberry PI platform, that is widely used in IoT applications

2. To introduce the implementation of distance sensor on IoT devices

Course Outcomes:

1. Ability to introduce the concept of M2M (machine to machine) with necessary protocols and get awareness in implementation of distance sensor

2. Get the skill to program using python scripting language which is used in many IoT devices

List of Experiments:

Using Raspberry Pi

1. Calculate the distance using a distance sensor

2. Basic LED functionality

3. Calculate temperature using a temperature sensor

4. Build an alarmed motion sensor

5. Make printer wireless

6. Add a power button to Raspberry pi

7. Build a network game server

8. Make music with sony Pi

9. Interface Pi Camera module with Raspberry Pi

10. Installing OS on Raspberry Pi

     a) Installation using Pilmager b) Installation using image File

B.Tech. Internet of Things (Minor) VIII Semester   L   T   P   C
3   0   0   3
M158AT: FOG AND EDGE COMPUTING FOR IOT

Course Objectives: This course gives an overview of Fog, Edge computing and Internet of Things (IoT) can be used as a way to meet application demands in intelligent IoT systems.

Course Outcomes:
1. Understand use of the IoT architecture with its entities and protocols, from the IoT devices.
2. Understand IoT + Fog + Cloud Infrastructures and its components and working of components and its performance.
3. Understand Optimization Problems in Fog and Edge Computing.
4. Explore Data Management in Fog Computing.

UNIT - I
Internet of Things (IoT) and New Computing Paradigms: Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Advantages of FEC: SCALE, FEC Achieves These Advantages: SCANC, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges. Addressing the Challenges in Federating Edge Resources: Introduction, The Networking Challenge, The Management Challenge, Miscellaneous Challenges.

UNIT - II
Integrating IoT + Fog + Cloud Infrastructures: System Modeling and Research Challenges: Introduction, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use-Case Scenarios, Integrated C2F2T Literature by Metrics, Future Research Directions. Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing, Management in Edge and Fog, Future Research Directions.

UNIT - III
Optimization Problems in Fog and Edge Computing: Introduction, Background / Related Work, Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, Metrics, Further Quality, Attributes, Optimization, Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing, Optimization Techniques, Future Research Directions.
Middlewares: Introduction, Need for Fog and Edge Computing Middleware, Design Goals, State-of- the-Art Middleware Infrastructures, System Model, Proposed Architecture, Case Study Example, Future Research Directions.

UNIT - IV
Lightweight Container Middleware for Edge Cloud Architectures: Introduction, Background/Related Work, Clusters for Lightweight Edge Clouds, Architecture Management – Storage and Orchestration, IoT Integration, Security Management for Edge Cloud Architectures, Future Research Directions. Data Management in Fog Computing: Introduction, Background, Fog Data Management, Future Research and Direction.

UNIT - V

Fog Computing Realization for Big Data Analytics: Introduction, Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation, Architecture, Configurations, Case Studies, Related Work, Future Research Direction. Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking: Introduction, Human Object Detection, Object Tracking, Lightweight Human Detection, Case Study, Future Research Directions.

TEXT BOOK:

1. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama.

REFERENCES:

1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya
2. Amir Vahid Dastjerdi and Rajkumar Buyya, - Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne.