Centre for Internet of Things

Python Programming: 3230224

COURSE OBJECTIVES

- To develop the understanding of algorithms, programming approaches and program documentation techniques in Python.
- To study the concepts of procedural and object oriented programming techniques in Python.
- To design and implement basic programming solutions using Python programming constructs.

Unit I

Introduction to Python: Formal and natural languages, Downloading and installing Python. Problem-solving methods and algorithm development. The first program, Variables, expressions, keywords, Operators, Expressions and statements, Interactive mode and script mode, Order of operations. Datatypes: Numeric, string, list tuple, dictionary, set.

Unit II

Function, ways of passing arguments to functions, user defined and inbuilt functions, lambda function. Control Statements: Conditional and unconditional branching, while loop, for loop, loop control statements, range function. Numeric, String, list, tuple, dictionary and set manipulation operations using loops and inbuilt manipulation functions. Packages and modules in python.

Unit III

Exception and File Handling: Errors vs exceptions, Exceptions handling with try block,handling multiple exceptions, writing your own exceptions,file handling modes, reading, writing and appending a file, Handling file exceptions.

Unit IV

Object oriented programming: Characteristics and features of OOPS, Classes and objects, constructors and destructors, defining member variables and functions, visibility modes, static members.

Unit V

Polymorphism: Introduction, Type of Polymorphism: Compile Time Polymorphism & Run Time Polymorphism, polymorphism in python. Inheritance: Introduction, Visibility Modes, Types of Inheritance: Single Level, Multilevel, Multiple, Hybrid, Multipath.

Association, Aggregation and composition. Array manipulation and visualization using numpy and matplotlib libraries.

RECOMMENDED BOOKS

- Python Crash Course: A Hands-On, Project-Based Introduction to Programming, By Eric Matthes.
- Learn Python the Hard Way: thirdEdition T.R. Padmanabhan, Programming with Python, Springer, first Ed., 2016.
- Kenneth Lambert, Fundamentals of Python: First Programs, Cengage Learning, first Ed., 2012.

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1. define basics syntax and features of python programming language

CO2. solve computational problem using python language.

CO3. take part in online coding platforms.

CO4. inspect the python program for errors.

CO5. design a program using the features of object oriented concept.

CO6. construct the python code for real world problem using the libraries.

IV Semester

Syllabus

2020-2021

B.Tech.

in

Internet of Things(IoT)

Madhav Institute of Technology & Science

Gwalior-474005

Centre for Internet of Things

Data Structure: 3230223

COURSE OBJECTIVES

- To be familiar with the use of data structures as the foundational base for computer solutions to problems.
- To understand various techniques of searching and sorting.
- To understand basic concepts about stacks, queues, lists, trees and graphs.

Unit-I

Introduction to Data Structures: Algorithms & their characteristics, asymptotic notations. arrays and its representations, index to address translation. Link list: Introduction, implementation of linked list, operations, circular link list, doubly linked list, polynomial manipulation using linked list.

Unit-II

Stacks: Concepts and implementation of stacks, operations on stack, conversion of infix to postfix notation, evaluation of postfix expression, recursion.

Queues: Concepts and implementation, operations on queues, dequeue, priority queues, circular queues and application.

Unit-III

Trees: Types, terminology, binary tree -representations, traversal, conversion of general tree to binary tree, binary search tree, threaded binary tree and height balanced tree.

Unit-IV

Graphs: Background, graph theory terminologies, representation of graphs- sequential & linked representation, path matrix, graph traversals- BFS, DFS, spanning trees, applications of graph.

Unit-V

Searching &Sorting: Linear search, binary search, bubble sort, selection sort, insertion sort, quick sort, merge sort, radix sort and heap sort, comparison between sorting techniques, hashing and collision resolution techniques.

RECOMMENDED BOOKS

- Data Structures, Algorithms and Applications in C++, SartajSahni, 2nd Edition.
- An Introduction to Data Structures with Applications, Jean-Paul Tremblay, Mcgraw hill.
- Data Structures & Algorithms, Aho, Hopcroft & Ullman, original edition, Pearson Publication.

COURSE OUTCOMES

After completion of this course, the students would be able to:

1. **Analyze** fundamental concepts of algorithms and their performance metrics
2. **Evaluate** the operations of linear and non-linear data structures
3. **Select** the suitable data structure for solving specific problems effectively
4. **Evaluate** the efficiency and applications of diverse data structures
5. **Formulate** optimal algorithmic solutions for diverse problems

IOT EMBEDDED SYSTEMS DESIGN: 2230422

Course Objective: To understand the concept of embedded system, microcontroller, different components of microcontroller and their interactions. To learn ARM microcontrollers to perform various tasks. To understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.

Course outcomes focused on employability/entrepreneurship and skill development

SNo.	Course Outcome (CO)	Mapping
1	**Explain** the architecture and advanced features of embedded processors and microcontrollers	Skill Development
2	**Describe** the function of PIC/ARM processor registers, instruction pipeline and interrupts	Skill Development
3	**Use** the instructions, addressing modes, conditional instructions to program embedded processors and microcontrollers	Employability
4	**Analyze** the architectures, instructions, interfacing and applications of Raspberry Pi board	Skill Development
5	**Compare** advanced intel Galileo/Edison microprocessors with other classical microprocessors	Skill Development
6	**Explain** the architecture and advanced features of embedded processors and microcontrollers	Skill Development

Unit 1:

Embedded and Microcontroller Concepts: Introduction to embedded processors, Application Areas, Categories of embedded processors, Hardware architecture, Software architecture, Application software, Communication software, Introduction to Harvard & Von Neumann Architectures, CISC & RISC Architectures.

Unit 2:

Embedded Serial Communication: SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), USB. Communication under IoT: IoT Protocol: MQTT, CoAP, XMPP and AMQT, IoT Communication Models, IoT Communication Technologies: Bluetooth, BLE, Zig-Bee, Zwave, NFC, RFID, LiFi, Wi-Fi, Interfacing of Communication Technologies, Embedded Programming.

Unit 3:

ARM: ARM design philosophy, data flow model and core architecture, registers, program status register, instruction pipeline, interrupts and vector table, operating modes and ARM processor families. Instruction Sets: Data processing instructions, addressing modes, branch, load, store instructions, PSR instructions, and conditional instructions.

Unit 4:

Raspberry Pi: Raspberry Pi board and its processor, Programming the Raspberry Pi, Communication facilities on Raspberry Pi (I2C, SPI, UART), Interfacing of sensors and actuators.

Unit 5:

Intel Galileo or Edison microprocessors for Embedded System and IoT, Application-specific integrated circuit (ASIC), Application-specific standard parts (ASSPs), System-on-Chip (SoC), Field-Programmable Gate Arrays (FPGA), Single Board Computers (SBC).

Text Books:

1. Muhammod Ali Mazidi, Rolin D. Mckinlay& Danny Sansey, "PIC Microcontroller and Embedded System SPI, UART using Assembly & C for PICI8," Pearson International Edition. 2008.
2. A. N. Sloss, D. Symes, and C. Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Elsevier, 2008.
3. S. Monk, "Programming the Raspberry Pi" McGraw-Hill Education, 2013
4. John .B. Peatman, "Design with PIC Microcontroller", Prentice Hall, 1997.
5. Steave Furber, "ARM system-on-chip architecture", Addison Wesley, 2000.

SOFTWARE ENGINEERING: 2230423

Course Objective: To understand the nature of software development and software life cycle process models, agile software development, SCRUM and other agile practices.To understand project management and risk management associated with various types of projects.To know basics of testing and understanding concept of software quality assurance and software configuration management process.

Course outcomes focused on employability/entrepreneurship and skill development

SNo.	Course Outcome (CO)	Mapping
1	**Analyze** the foundational concepts of software engineering.	Skill Development
2	**Discuss** advanced concepts in software design illustrating their interconnections and applications.	Skill Development
3	**Compare** various techniques for software project management and estimation.	Skill Development
4	**Implement** software using cutting-edge tools and techniques	Employability
5	**Develop** and test the software through different approaches.	Entrepreneurship

Unit 1:

Introduction to Software Engineering: Definition, Software Engineering-Layered Technology, Software Characteristics and Components, **Software Model:** Software Development of Life Cycle Model (SDLC), The Waterfall Model, Iterative Waterfall Model, Prototyping Model, Spiral Model, RAD Model. **Selection Criteria of Model**: Characteristics of Requirements, Status of Development Team, Users Participation, Type of Project and Associated Risk.

Unit 2:

Requirement Engineering: Definition, Requirement Engineering Activity ,**Types of Requirement-** Functional and Non-functional Requirements, User and System Requirements, Requirement Elicitation Methods, Requirement Analysis Methods, Requirement Documentation (SRS), Requirement Validation, Requirement Management.

Unit 3:

Design Concept, Principle and Methods: Design Fundamentals, Design Principles, Effective Modular Design, Design Representations, Architectural Design, Procedural Design, Data Directed design, Real Time Design, Object Oriented Design, Coupling and Cohesion.

Unit 4:

Software Metrics, Project Management and Estimation: Metrics in Process and Project Domains, Software Measurement, Software Quality Metrics, **Project Management-** Basics-People, Product, Process, Project, **Estimation-** Software Project Estimation, Decomposition Techniques- Function Point Estimation, Line of Code (LOC) Based estimation, Empirical Estimation, COCOMO Model, Project Scheduling Techniques.

Unit 5:

Software Testing: Definitions, Software Testing Life Cycle (STLC), , Test Case Design, Strategic Approach to Software Testing- Verification & Validation , Strategic Issues, Criteria for Completion

of Testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Black Box Testing Techniques, White Box Testing Techniques, Acceptance Testing.

Text Books:

1. Software Engineering, Sommerville, Pearson.
2. Software Engineering: A Practitioner's Approach, Roger S. Pressman, McGraw Hill.
3. Software Engineering, K.K. Agrawal & Yogesh Singh, New Age Publication.
4. Software Engineering, Rajib Mall, PHI

IOT ARCHITECTURE & PROTOCOLS: 2230424

Course Objective: Familiarize the student with the basic taxonomy and terminology of the IOT Architecture & Protocols.Provide detailed knowledge about various layers, protocols and devices that facilitate IoT service.

Course outcomes focused on employability/entrepreneurship and skill development

SNo.	Course Outcome (CO)	Mapping
1	**Explain** various concepts, terminologies, and architecture of IoT systems	Skill Development
2	**Describe** the architectural views of IoT and various design challenges	Skill Development
3	**illustrate** data link and network layer protocols.	Skill Development
4	**Analyze** various transport and session layer Protocols	Employability
5	**Explain** the need of IoT service layer protocols.	Skill Development

Unit 1:

Introduction: IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, IoT Communication models, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics.

Unit 2:

IoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints.

Unit 3:

IoT Data Link Layer & Network Layer Protocols: PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4,IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP.

Unit 4:

IoT Transport & Session Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS), Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.

Unit 5:

IoT Service Layer Protocols & Security Protocols: Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC802.15.4 , 6LoWPAN, RPL, Application Layer: UPnP, SCADA, Authentication Protocols.

Text Books:

1. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Daniel Minoli, ISBN: 978-1-118-47347-4, Willy Publications ,2016
2. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, 1st Edition, Academic Press, 2015.

Data Mining & Pattern Warehousing: 230602

Course Objective:

- To understand the significance of data mining in real-world perspective.
- To gain understanding of data mining techniques, algorithms and commonly used tools.
- To develop ability for applying data mining techniques and tools for solving real-world problems.

Course outcomes focused on employability/entrepreneurship and skill development

S No.	Course Outcome (CO)	Mapping
1	**Describe** basics of data mining including data types, advanced databases, and functionalities	Skill Development
2	**Choose** appropriate data pre-processing techniques for specific requirements	Skill Development
3	**Compare** various association rule mining algorithms for practical applications	Skill Development
4	**Explain** different methods for classification, prediction, and cluster analysis	Employability
5	**Apply** the concept of pattern warehousing to address intricate problems across domains	Employability
6	**Describe** basics of data mining including data types, advanced databases, and functionalities	Employability

Unit - I

Introduction: Motivation, importance, Data type for Data Mining: Relational Databases, Data Ware-Houses. Transactional Databases, Advanced Database System and Its Applications, Data Mining Functionalities, Concept/Class Description, Association Analysis Classification & Prediction, Cluster Analysis, Outliner Analysis, Classification of Data Mining Systems, Major Issues in Data Mining.

Unit - II

Data Pre-processing: Data Cleaning, Data Integration and Transformation and Data Reduction. Discretization and Concept Hierarchy Generation. Data Mining Primitives Languages and System Architectures, Concept Description, Characterization and Comparison Analytical, Characterization.
Data Warehouse and OLTP Technology for Data Mining: Differences between Operational Database Systems & Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology.

Unit – III

Mining Association Rules in Large Databases: Association Rule Mining: Market Basket Analysis, Basic Concepts, Mining Single Dimensional Boolean Association Rules from Transactional Databases: The Apriori Algorithm, Generating Association Rules from Frequent Items, Improving the Efficiency of Apriori, other Algorithms & their Comparison, Mining Multilevel Association Rules, Multidimensional Association Rules, Constraint Based Association Rule Mining.

Unit - IV

Classification & Prediction and Cluster Analysis: Issues Regarding Classification & Prediction, Different Classification Methods, Prediction, Cluster Analysis, Major Clustering Methods, Currently Available Tools.

Unit - V

Pattern Warehousing System: Pattern Warehouse, Process flow for Pattern Warehouse, Benefits of Pattern Warehousing, Difference between Pattern Warehousing and Data Warehousing, Architectural aspects of Pattern Warehousing, Types of Pattern Warehouses, Challenging Issues in Pattern Warehouse, Profitable Pattern Mining, Hesitation Mining, Case Study in Stock Market, Super Market.

Text Books:

1. Data Mining: Concepts and Techniques, Han and Kamber, Morgan Kaufmann Publications.
2. Data Mining Techniques, A. K. Pujari, Universities Press Pvt. Ltd.

Artificial Intelligence & Machine Learning: 230603

Course Objective:

- To provide the fundamental knowledge of Artificial Intelligence and Machine Learning.
- To present the basic representation and reasoning paradigms used in AI & ML.
- To understand the working of techniques used in AI & ML.

Course outcomes focused on employability/entrepreneurship and skill development

S No.	Course Outcome (CO)	Mapping
1	**Define** basic concepts of Artificial Intelligence & Machine Learning.	Skill Development
2	**Illustrate** various techniques for search and processing.	Skill Development
3	**Identify** various types of machine learning problems and techniques.	Skill Development
4	**Analyse** various techniques in Artificial Intelligence, ANN & Machine Learning.	Employability
5	**Apply** AI and ML techniques to solve real world problems.	Employability
6	**Build** AI enabled intelligent systems for solving real world problems.	Employability

Unit I

Introducing Artificial Intelligence: Definition, Goals of AI, Task of AI, Computation, Psychology and Cognitive Science, Perception, Understanding and Action. Artificial Intelligence vs Machine Learning vs Deep Learning and other related fields. Applications of Artificial intelligence and Machine Learning in real world.

Unit II

Problem, Problem Space and Search: Production System, Blind Search: BFS & DFS, Heuristic Search, Hill Climbing, Best First Search.
Introduction to Neural Networks: History, Biological Neuron, Artificial Neural Network, Neural Network Architectures, Classification, & Clustering.

Unit III

Introduction to Machine Learning: Traditional Programming vs Machine Learning.
Key Elements of Machine Learning: Representation, Process (Data Collection, Data Preparation, Model Selection, Model Training, Model Evaluation and Prediction), Evaluation and Optimization. Types of Learning: Supervised, Unsupervised and Reinforcement Learning. Regression vs Classification Problems.

Unit IV

Supervised Machine Learning: Linear Regression: Implementation, Applications & Performance Parameters, Decision Tree Classifier, Terminology, Classification vs Regression Trees, Tree Creation with Gini Index and Information Gain, IDE3 Algorithms, Applications and Performance Parameters. Random Forest Classifier, Case Study on Regression and Classification for solving real world problems.

Unit V

Unsupervised Machine Learning: Introduction, Types: Partitioning, Density Based, DBSCAN, Distribution Model-Based, Hierarchical, Agglomerative and Divisive, Common Distance Measures, K-Means Clustering Algorithms, Case Study on Clustering for solving real world problems.

Text Books:

1. Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, Prentice Hall.
2. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill.
3. Introduction to AI & Expert System: Dan W. Patterson, PHI.
4. Pattern Recognition and Machine Learning, Christopher M. Bishop
5. Introduction to Machine Learning using Python: Sarah Guido
6. Machine Learning in Action: Peter Harrington