B.Sc. (AI & ML)

CBCS Pattern with Effect from the Academic Year 2022-2023

Structure of Curriculum

Course Title	Hours/Week		Credits
	Theory	Practical	
Semester –I			
Fundamentals of Information Technology	4	3	4+1=5
Semester –II			
Object Oriented Programming with Python	4	3	4+1=5
Semester –III			
Operating Systems with Linux	4	3	4+1=5
Semester –IV			
Data Analytics	4	3	4+1=5
Semester –V			
Artificial Intelligence	4	3	4+1=5
Semester –VI			
Machine Learning	4	3	4+1=5

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SEMESTER – I
Fundamentals of Information Technology

Theory	**4 Hours/Week**	**4 Credit**	**Internal marks = 20**
Practical	**3 Hours/Week**	**1 Credit**	**External Marks = 80**

Objectives:

1. **To deal with the basic concepts of computers.**
2. **To discuss about the computer hardware, its components and basic computer architecture.**
3. **To understand the basic computer software including the operating system andits concepts.**
4. **To introduce the software development process**
5. **To introduce the basic concept of programming**

Outcomes:

Students should be able to

1. Identify the components of a computer and their functions.
2. Understand the concept of networking, LAN, Internet, and working of www.
3. Understand the notion of problem solving using computer by programming
4. Understand the notion of Software Project and the Process of software development

Unit-I

Data and Information: Introduction, Types of Data, Simple Model of a Computer, Data Processing Using a Computer, Desktop Computer [Reference 1]

Acquisition of Numbers and Textual Data: Introduction, Input Units, Internal Representation of Numeric Data, Representation of Characters in Computers, Error-DetectingCodes [Reference 1]

Unit-II

Data Storage: Introduction, Storage Cell, Physical Devices Used as Storage Cells, Random Access Memory, Read Only Memory, Secondary Storage, Compact Disk Read Only Memory (CDROM), Archival Store [Reference 1]

Central Processing Unit: Introduction, Structure of a Central Processing Unit, Specifications of a CPU, Interconnection of CPU with Memory and I/O Units, Embedded Processors [Reference 1]

Unit-III

Computer Networks: Introduction, Local Area Network (LAN), Applications of LAN, Wide Area Network (WAN), Internet, Naming Computers Connected to Internet, Future of Internet Technology [Reference 1]

Operating systems: Functions of operating systems, types of operating systems, Device & Resourcemanagement

Input Output Devices: Introduction, Keyboard, Video Display Devices, Touch ScreenDisplay, E-Ink Display, Printers, Audio Output [Reference 1]

Computer Software: Introduction, Operating System, Programming Languages, Classification of Programming Languages, Classification of Programming Languages Basedon Applications [Reference 1]

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SEMESTER – I

Fundamentals of Information Technology (Lab)

Practical 3 Hours/Week 1 Credit Marks: 25

Objective

The main objective of this laboratory is to familiarize the students with the basic hardware and software in computers

Exercises

1. Assembly and disassembly of a system box and identifying various parts inside the system box to recognize various parts of a typical computer system
2. Assembly and disassembly of peripheral devices- keyboard and mouse and study of their interface cables, connectors and ports.
3. Installation of Operating Systems-Windows and Linux
4. Disk defragmentation using system tool.
5. Procedure of disk partition and its operation (Shrinking, Extending, Delete, Format).
6. Installing and uninstalling of device drivers using control panel.
7. Working practice on windows operating system and Linux operating system: creating file, folder. Copying, moving, deleting file, folder
8. User Account creation and its feature on Windows Operating System and Changing resolution, color, appearances, and Changing System Date and Time.
9. Installation and using various wireless input devices (Keyboard/Mouse/Scanners etc.,)under Windows/Linux.
10. Study of various types of memory chips and various types of hard disk drives,partition and formatting of hard disk.
11. Installation of scanner, modem and network cards in Windows/Linux.
12. Assembly and disassembly of printer, installing a printer, taking test page, and using printer under Windows/Linux.
13. Installation of application software's – Office Automation, Anti-Virus.
14. Demonstrate the usage of Word and Power point in Windows and Linux
15. Configure Internet connection, Email Account creation, reading, writing and sending emails with attachment.

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Unit-IV

Database Management Systems: Data models, RDBMS, SQL, Database Transactions, data centers, cloud services

The Software Problem: Cost, Schedule, and Quality, Scale and Change [Reference 2] **Software Processes**: Process and Project, Component Software Processes, Software Development Process Models [Reference 2]

Programming Principles and Guidelines: Structured Programming, Information Hiding, Some Programming Practices, Coding Standards [Reference 2]

References

1. V Rajaraman. Introduction to Information Technology, 3rd Edition, PHI Learning Private Limited, 2018
2. Pankaj Jalote. Concise Introduction toSoftware Engineering, Springer, 2011

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SEMESTER – II

OBJECT ORIENTED PROGRAMMING USING PYTHON

Theory	**4**	**Hours/Week**	**Internal marks = 20**
		4 Credit	**External Marks = 80**
Practical	**3**	**Hours/Week**	
		1 Credit	

UNIT I

Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Catching Exceptions Using try and except Statement, Functions, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

UNIT II

Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists, Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement. Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozenset.

UNIT III

Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules, Regular Expression Operations, Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module.

UNIT IV

Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism

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Text Books:

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

References:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
2. AurelienGeron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition,O'Reilly Media, 2017. ISBN – 13: 978-1491962299.
3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018. ISBN-13: 978-1491991732.

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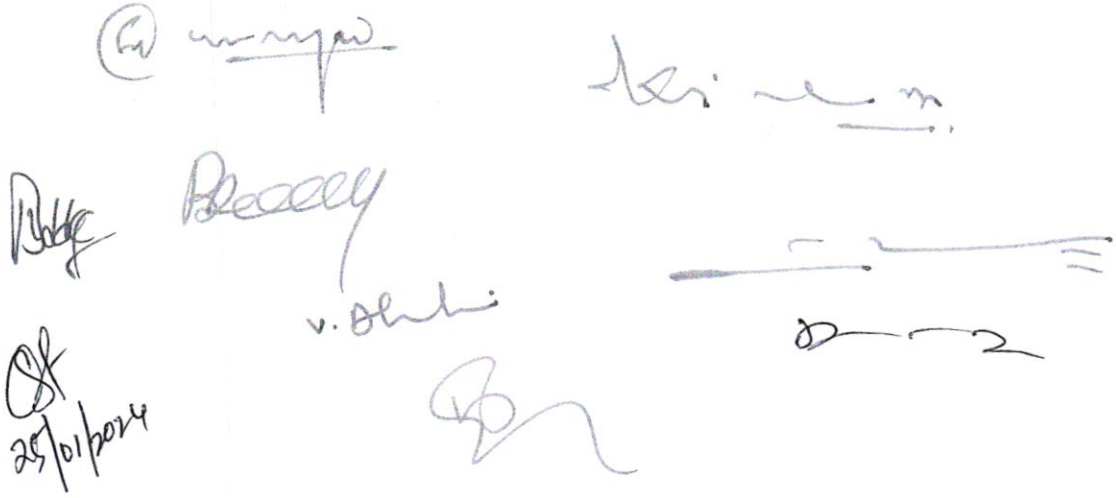
PYTHON PROGRAMMING LAB

Practical 3 Hours/Week 1 Credit Marks: 25

Course Objective:

To implement Python programs with conditionals and loops. Also represent compound data usingPython lists, tuples, dictionaries and Read and write data from/to files in Python.

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. First n prime numbers
8. Multiply matrices
9. Programs that take command line arguments (word count)
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame



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SEMESTER – III
Operating Systems with Linux

UNIT I

Operating System: Concept, Components of Operating System, Operating System Operations, Protection and Security. Computing Environment. Abstract View of OS: User view, System View, Operating System Services, System Calls: Concept, Types of System Calls. Computer System Architecture: Single-Processor Systems, Multiprocessor Systems. Types of Operating Systems: Batch Operating System, Multi-Programmed Operating System, Time-Shared Operating System, Real Time Operating System, Distributed Operating Systems. Process Management: Process Concept, Operation on Processes, Cooperating Processes, Inter-Process Communication, Threads. Linux Operating System: Introduction to Linux OS, Basic Commands of Linux OS.

UNIT II

Process Synchronization: Introduction, The Critical-Section Problem with solution, Bakery Algorithm, Synchronization hardware, Semaphores, Semaphores Implementation, Classical Problems of Synchronization with algorithms, Critical Regions, Monitors. CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling algorithms, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling. Linux Operating System: Process Management Commands and System Calls.

UNIT III

Deadlock: System Models, Deadlock Characterization, Resource Allocation Graph, Deadlock Prevention, Avoidance, Detection and Recovery, Banker's algorithm. Memory Management: Main Memory: Contiguous Memory Allocation, Fragmentation, Paging, And Segmentation. Virtual Memory: Demand Paging, Page Replacement, Page replacement algorithm, Allocation of frames, Thrashing. Linux Operating System: Memory Management Commands and System Calls.

UNIT IV

File, Devices and Secondary Storage Management: File-System Interface: Concepts, Access Methods, Directory and Disk Structure. File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management. Devices: Types of devices, Channels and Control Unit, Multiple Paths, Block Multiplexing. Secondary Storage: Mass-Storage Structure, Disk Structure, Disk Scheduling Algorithms, Disk Management, RAID structure of disk. Linux Operating System: File Management Commands and System Calls.

TEXT BOOKS:

1. Silberschatz, Galvin, Greg, "Operating System Concepts", Wiley and Sons, 9th Edition, 2015.
2. Sumitabha Das, "Unix concept and Programming", McGraw Hill education, 4th Edition, 2015.

REFERENCE BOOKS:

1. Godbole, Achyut, "Operating System", McGraw-Hill Education, 2nd Edition, 2005.
2. William Stallings, "Operating System: Internals and Design Principles", Person, 9th Edition, 2018.
3. A. S. Tanenbaum, "Modern Operating Systems ", Pearson, 3rd Edition, 2007.
4. Kenneth H. Rosenet al, "UNIX: The Complete Reference", McGraw-Hill/Osborne, 6th Edition, 2017.

5. Dhananjay M. Dhamdhere, "Operating System A concept based approach", Tata McGraw-Hill, 2nd Edition, 2006.
6. Madnick E. and Donovan J., "Operating Systems", Tata McGraw Hill, 2001.

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Operating Systems with Linux Lab

Practical 3 Hours/Week 1 Credit Marks: 25

LEARNING OBJECTIVES:

In this course, the learners will be able to develop the working expertise of the following:-

1. Perform Linux Operating System Installation.

2. Implement the policies of Process Management, Inter process communication and Memory Management.

3. Apply the basics of File Management, Device and Disk Storage Management

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SEMESTER – IV
DATA ANALYTICS

UNIT – I:

Introduction to Big Data: Introduction to Big Data Platform – Challenges of Conventional systems – Web data – Evolution of Analytic scalability, analytic process and tools, Analysis vs Reporting – Modern data analytic tools,

Statistical Concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT – II:

Data Analysis: Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and Kernel methods

Analysis of Time Series: Linear systems analysis, nonlinear dynamics – Rule induction –

Neural Networks: Learning and and Generalisation, competitive learning, Principal component analysis and neural networks

Fuzzy Logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT – III:

Mining Data Streams: Introduction to Streams Concepts – Stream data model and architecture – Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a Window – Decaying window – Real time Analytics Platform (RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

UNIT – IV:

Frequent Itemsets and Clustering: Mining Frequent itemsets – Market based Modeling – Apriori Algorithm – Handling large data sets in Main Memory – Limited Pass Algorithm – Counting frequent itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means. Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern-based clustering methods – Clustering in non-Euclidean space – Clustering for streams and Parallelism.

TEXT BOOKS:

1.
Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007

2. Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012

REFERENCES:

1. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, John Wiley & Sons, 2012

2. Big Data Glossary, Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, Pete Warden, O'Reilly, 2011

3. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, 2nd Edition, Elsevier, 2008

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DATA ANALYTICS LAB

Practical 3 Hours/Week 1 Credit Marks: 25

COURSE OBJECTIVES:

- To explore and understand various data management and handling methods
- To understand the concept of data analytics
- To use Big Data tools and techniques for data processing

Data Processing Tool – Hive (NoSQL query based language)
Hive command line tool allows you to submit jobs via bash scripts.
Identifying properties of a data set:
We have a table 'user data' that contains the following fields:
data_date: string
user_id: string
properties: string
The properties field is formatted as a series of attribute=value pairs.
Ex: Age=21; state=CA; gender=M;

Lab Instructions:

1. Create the table in HIVE using hive nosql based query.
2. Fill the table with sample data by using some sample data bases.
3. Write a program that produces a list of properties with minimum value(min_value), largest value(max_value) and number of unique values. Before you start, execute the prepare step to load the data into HDFS.
4. Generate a count per state.
5. Now that extracted the properties, calculate the number of records per state.
6. Write a program that lists the states and their count from the data input.

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SEMESTER – V

ARTIFICIAL INTELLIGENCE

UNIT – I:

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT – II:

Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth limited Search.

Search with partial information (Heuristic search) Greedy best first search, A* search, Memory -bounded heuristic search

Local search algorithms- Hill climbing, Simulated annealing search, Local beam search, Genetic algorithms

UNIT – III:

Constraint Satisfaction Problems: Backtracking search for CSP's, Local search for CSP

Game Playing: Adversial search, Games, Minimax algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

UNIT – IV:

Knowledge Representation: Procedural Versus Declarative knowledge, Using Predicate logic, representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification.

UNIT – V:

Learning: What is learning, Learning by Taking Advice, Learning in Problem-solving, Learning from example: induction, Explanation-based learning. Introduction to Neural Networks, Differenttypes of Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks.

Expert System: Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells-examples, Knowledge acquisition skills-examples.

TEXT BOOKS:

1. Artificial Intelligence A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, Pearson Education
2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 2nd Edition, 2008
3. Artificial Neural Networks, B. Yagna Narayana, PHI

REFERENCES:

1. Expert Systems: Principles and Programming, Giarrantana, Riley, 4th Edition, Thomson
2. PROLOG Programming for Artificial Intelligence, Ivan Bratka, 3rd Edition, Pearson Education
3. Neural Networks, Simon Haykin, PHI
4. Artificial Intelligence, Patrick Henny Winston, 3rd Edition, Pearson Education

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ARTIFICIAL INTELLIGENCE LAB

Practical 3 Hours/Week 1 Credit Marks: 25

COURSE OBJECTIVES:

- To apply various AI search algorithms
- To explore various knowledge representation concepts and Logic in AI

1.Write a program to solve any problem using depth first search.

2.Write a program to solve any problem using best first search algorithm

3. Write a program to implement depth limit search

4.Write a program to implement heuristic approach

5.Write a program to implement tic_tac_toe with min_max algorithm

6.Write a program to implement A*algorithm

7. Illustrate Knowledge representation using online tools.

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SEMESTER – VI
MACHINE LEARNING

UNIT – I:

Introduction to Machine Learning: Human learning, types of human learning, machine learning, types of machine learning, problems not to be solved using machine learning, applications of machine learning, tools in machine learning, Issues in Machine Learning.

Supervised Learning: Classification

Introduction, example of supervised learning, classification model, classification learning steps, classification algorithms: K-Nearest Neighbour (k-NN), Decision tree, Random Forest model, Support vector machines.

UNIT – II:

Supervised Learning: Regression

Introduction, examples of regression, common regression algorithms: simple linear regression, multiple linear regression, assumptions in regression analysis. Main problems in regression analysis, improving accuracy of the linear regression model, polynomial regression model, logistic regression model, maximum likelihood estimation.

UNIT – III:

Unsupervised Learning

Introduction, unsupervised vs supervised learning, applications of unsupervised learning, clustering: clustering as a machine learning task, different types of clustering techniques, partitioning methods, k-medoids, hierarchical clustering, density-based methods – DBSCAN.

UNIT – IV:

Modelling and Evaluation:

Selecting a model: Predictive and Descriptive models, Training a model (for supervised learning): Holdout method, K-fold cross-validation method, Bootstrap sampling, Lazy vs Eager learner. Model representation and interpretability: Underfitting, Overfitting, Bias – Variance trade-off. Evaluating performance of a model: Supervised learning – classification, regression, Unsupervised learning – clustering, Improving performance of a model.

TEXT BOOKS:

1. Machine Learning, Saikar Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson India
2. Machine Learning, Tom M. Mitchell, McGraw-Hill Education

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MACHINE LEARNING LAB

Practical 3 Hours/Week 1 Credit Marks: 25

COURSE OBJECTIVES:

- To get an overview of the various machine learning techniques
- To demonstrate single layer and multilayer feed forward neural networks
- To understand training, building and evaluate a model
- To demonstrate real word case study

1. Implement k-Nearest Neighbour (k-NN) and Decision Tree learning algorithm
2. Implement Random Forest model learning algorithm and Support vector machines learning algorithm

3: Implement Linear Regression learning algorithm.
4: Implement logistic Regression learning algorithm.
5: Implement unsupervised k-means algorithm
6: Model Training:
7. Holdout, K-Fold cross validation and Bootstrap Sampling
8. Evaluating Model Performance:
9. Supervised Learning- Classification
10. Supervised Learning- Regression
11. Unsupervised Learning-Clustering

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