IV - SEMESTER

Scheme of Instruction & Examination

B. E. - Artificial Intelligence and Data Science

AI&DS Semester - IV

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Contact Hours / week	CIE	SEE	
		Theory Courses							
1	1PC404AD	Operating Systems	3	0	0	3	40	60	3
2	1PC405AD	Statistical Analytics and Computing	3	0	0	3	40	60	3
3	1PC406AD	Foundations of Artificial Intelligence	3	1	0	4	40	60	4
4	1PC407AD	Software Engineering	3	0	0	3	40	60	3
5	1HS403HS	Human Values and Professional Ethics	3	0	0	3	40	60	2
		Practical / Laboratory Courses							
6	1PC455AD	Operating Systems Lab	0	0	2	2	40	60	1
7	1PC456AD	Java Programming Lab	0	0	2*2	4	40	60	2
8	1PC457AD	Statistical Analytics and Computing using Python Lab	0	0	2	2	40	60	1
9	1PW458AD	Skill Development Course - II	0	0	2	2	40	60	1
Total Credits						**26**	**360**	**540**	**20**

Course Code	Course Title						Core/Elective
1PC404 AD	OPERATING SYSTEMS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	2	40	60	3

COURSE OBJECTIVES :

1. To learn the fundamentals of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication.
3. To learn the mechanisms involved in memory management in contemporary OS.
4. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection.
5. To know the components and management aspects of concurrency management.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Describe the concepts of OS structure and Process synchronization.
2. Evaluate and design different process scheduling algorithms.
3. Identify the rationale behind various memory management techniques along with issues and challenges of main memory and virtual memory.
4. Compare different file allocation methods and decide appropriate file allocation strategies.
5. Describe the mechanisms available is OS to control access to resources and provide system security.

UNIT - I

Introduction : Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel OperatingSystems, Concept of Virtual Machine.

UNIT - II

Processes : Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

Thread : Definition, Variousstates, Benefits of threads, Types of threads, Concept of multithreads.

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling Criteria, Scheduling algorithms, multiprocessor scheduling.

UNIT - III

Process Synchronization : Inter-process Communication : Critical Section, Race Conditions, Mutual Exclusion, Peterson's Solution, classical problems of synchronization : The Bounded buffer problem, Producer \ Consumer Problem, reader's & writer problem, Dinning philosopher's problem. Semaphores, Event Counters, Monitors, Message Passing,

Deadlocks : Definition, Necessary and sufficient conditions for Deadlock, Methods for Handling : Deadlocks : Deadlock prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

UNIT-IV

Memory Management : Basicconcept, Logical and Physical address map, Memory allocation : Contiguous Memory allocation, fragmentation and Compaction; Paging: Principle of operation - Page allocation - Hardware support for paging, structure of pagetable, Protection and sharing, Disadvantages of paging.

Virtual Memory : Basics of Virtual Memory - Hardware and control structures - Locality ofreference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms,Trashing.

UNIT - V

I/O Hardware : I/O devices, Device controllers, Direct memory access Principles of I/OSoftware : Goals of Interrupt handlers, Device drivers, Device independent I/O software.

File Management : Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods, Free-space management, directory implementation, efficiency and performance.

Secondary-Storage Structure : Disk structure, Disk scheduling algorithms, Disk Management, RAID structure.

TEXT BOOKS

1. Abraham Silberschatz, Peter B Galvin, Greg Gagne, Operating System Concepts Essentials, 9th Edition, Wiley Asia Student Edition, 2017.
2. William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India, 2016.
3. Andrew S. Tanenbaum (2007), Modern Operating Systems, 2nd edition, Prentice Hall of India, India.

REFERENCE BOOKS

1. Maurice Bach, Design of the Unix Operating Systems, 8th Edition, Prentice-Hall of India, 2009.
2. Daniel P. Bovet, Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O'Reilly and Associates.

Course Code	Course Title						Core/Elective
1PC405 AD	STATISTICAL ANALYSIS AND COMPUTING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	2	40	60	3

COURSE OBJECTIVES :

1. To understand Statistical parameters for data analytics.
2. To use Numpy for organizing and analyzing data.
3. To use pandas for summarizing and analysis of data.
4. To use of statistical methods for cleaning and preparation of data.
5. To performs aggregation of data and understand analysis of time series data.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Understand Statistical parameters for data analytics.
2. Use Numpy for organizing and analyzing data.
3. Use pandas for summarizing and analysis of data.
4. Use of statistical methods for cleaning and preparation of data.
5. Performs aggregation of data and understands analysis of time series data.

UNIT - I

Python Language Basics, IPython, and Jupyter Notebooks: The Python Interpreter, IPython Basics, Python Language Basics

Built-in Data Structures, Functions, and Files : Data Structures and Sequences, Functions, Files and the Operating System

UNIT - II

NumPy Basics : Arrays and Vectorized Computation: The NumPyndarray: A Multidimensional Array Object, Universal Functions, Array-Oriented Programming with Arrays, File Input and Output with Arrays, Linear Algebra, Pseudorandom Number Generation, Example: Random Walks.

UNIT - III

PANDAS : Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Reading and Writing Data in Text Format, Binary Data Formats, Interacting with Web APIs, Interacting with Databases.

UNIT - IV

Data Cleaning and Preparation : Handling Missing Data, Data Transformation, String Manipulation.

Data Wrangling : Join, Combine, and Reshape: Hierarchical Indexing, Combining and Merging Datasets, Reshaping and Pivoting.

UNIT - V

Data Aggregation and Group Operations: GroupBy Mechanics, Data Aggregation, Apply : General split-apply-combine, Pivot Tables and Cross-Tabulation

Time Series : Date and Time Data Types and Tools, Time Series Basics, Date Ranges, Frequencies, and Shifting, Periods and Period Arithmetic, Resampling and Frequency Conversion, Moving Window Functions.

TEXT BOOKS

1. Wes McKinney, Python for Data Analysis- DATA WRANGLING WITH PANDAS, NUMPY, AND IPYTHON, O-Reilly, 2018.
2. Fabio Nelli, Python Data Analytics, Apress, 2015.

REFERENCE BOOKS

1. Peters Morgan, Data Analysis From Scratch With Python Step By Step Guide, AI Sciences
2. Andrew Park, Python for Data Analysis: A Step-By-Step Guide to Master the Basics of Data Science and Analysis in Python Using Pandas, Numpy And Ipython

Course Code	Course Title						Core/Elective
1PC406 AD	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	1	-	-	40	60	4

COURSE OBJECTIVES :

1. To introduce the AI techniques to solve problems and search strategies to find optimal solution paths from start to goal state.
2. To introduces different knowledge representation methods in AI Programs.
3. To introduce different design techniques for Game Playing Programs.
4. To introduce the AI Agents their design, planning and learning techniques.
5. To introduce the natural language processing and expert systems.

COURSE OUTCOMES :

After the completion of course the students will be able to :

1. Understand fundamental AI concepts and identify a range of symbolic and non-symbolic AI techniques.
2. Demonstrate an understanding of various searching algorithms such as adversarial search and game-playing commonly used in artificial intelligence software.
3. Use different knowledge representation techniques used in AI Applications.
4. Demonstrate an understanding of agent based AI architectures, Planning and logic based agents.
5. Exploring Expert systems.

UNIT - I

Introduction : Artificial Intelligence and its applications, Artificial Intelligence Techniques

Problem solving techniques : State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, AO* search, Constraint satisfaction problem, Agenda Driven Search, Mean-end analysis, Min- Max Search, Alpha-Beta Pruning, Iterative Deepening.

UNIT-II

Knowledge representation : Mapping between facts and representations, Approaches to knowledge representation, procedural vs declarative knowledge, Forward vs. Backward reasoning, Matching, conflict resolution, Weak and Strong filler structures.

UNIT- III

Non Monotonic and Statistical Reasoning : on monotonic Logic, Default Logic, Circumscription, Bayes Theorem, Bayesian Network, Dempster Shafer Theory, Fuzzy sets, Fuzzy Logic, Defuzzification.

UNIT-IV

Planning and Learning Agents : Intelligent Agents, Nature and structure of Agents, Learning Agents, Introduction to different Forms of Learning, The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

UNIT - V

Introduction to Learning and Expert system : Expert systems, Expert system examples, Expert System Architectures, Rule base Expert systems, Non Monotonic Expert Systems, Decision tree base Expert Systems.

TEXT BOOKS

1. AI: A Modern Approach Stuart J. Russel, Peter Norvig Pearson Education Latest Edition, 2012.
2. Artificial Intelligence Elaine Rich, Knight McGraw Hill Third Edition 2010.
3. Artificial Intelligence, Saroj Kaushik Cengage Learning, First Edition 2011.

REFERENCES

1. Artificial Intelligence, Partick Henry Winston Addison Wesley Latest Edition 2012.
2. Artificial Intelligence George Luger Pearson Education Latest Edition 2010.

Course Code	Course Title						Core/Elective
1PC407AD	SOFTWARE ENGINEERING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Describe and compare various software development methods and understand the context in which each approach might be applicable.
2. To impart knowledge on various phases, methodologies and practices of software development.
3. To apply the project management and analysis principles to software project development.
4. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metric.
5. To apply the design & testing principles to software project development.

COURSE OUTCOMES :

After the completion of course the students will be able to :

1. Acquired working knowledge of alternative approaches and techniques for each phase of SDLC.
2. Judge an appropriate process model(s) for software project attributes and analyze requirements for project development.
3. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting.
4. Concede product quality through testing techniques employing appropriate metrics by understanding the practical challenges associated with the development of a significant software system.
5. Apply the software engineering principles in real time project development.

UNIT - I

Introduction to Software : What is software? Types of software, Characteristics of Software Attributes of good software.

Software Engineering : What is software engineering, Software engineering costs? What are the key challenges facing software engineering, Systems engineering & software Engineering, SDLC.

Software Development Process Models : Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

UNIT - II

Software Engineering Principles : SE Principles, Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment.

Software Requirement Analysis and Specification : System and software requirements, Types of software requirements, Elicitation and analysis of requirements, Requirement validation, Requirement specification, Feasibility.

UNIT - III

Building the Analysis Model : Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling,Class-based Modeling.

Design Engineering : Design Process and Quality, Design Concepts, the Design Model.

Performing User Interface Design : The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface DesignSteps, Design Evaluation.

UNIT - IV

Creatingan Architectural Design : Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Coding : Programming languages and development tools, Selecting languages and tools Good programming practices, Coding Standards.

UNIT - V

Software Testingand Quality Assurance : Verification and validation Techniques of testing Black-box and White-box testing Inspections Levels of testing Unit testing, Integration Testing, Interface testing, System testing, Alpha and beta testing,

Regression testing Design of test cases, Quality management activities: Product and process quality Standards, ISO900, Capability Maturity Model (CMM), Risk management.

Debugging : Debugging Techniques,The Art of Debugging.

Current trendsin Software Engineering Software Engineering for projects and products.

TEXT BOOKS

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw Hill, 2009.
2. Software Engineering by Ian Sommerville,7th edition, Addison-Wesley.
3. Fundamentals of Software Engineering by Rajib Mall.

REFERENCE BOOKS

1. Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, Oxford University Press, 1996.
2. PankajJalote, An Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House, 200.

Course Code	Course Title						Core/Elective
1PC455AD	OPERATING SYSTEMS LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To Learn various system calls in Linux.
2. ToLearn different types of CPU scheduling algorithms.
3. ToDemonstrate the usage of semaphores for solving synchronization problem
4. ToUnderstand memory management techniques and different types of fragmentation.
5. To Learn various disk scheduling algorithms.

COURSE OUTCOMES :

After the completion of course the students will be able to :

1. Use different system calls for writing application programs.
2. Evaluate the performance of different types of CPU scheduling algorithms.
3. Implement producer-consumer problem, reader-writer's problem, Dining philosopher's problem.
4. Simulate Banker's algorithm for deadlock avoidance.
5. Implement paging replacement and disk scheduling techniques.

List of Programs (preferred programming language is C)

Perform a case study by installing and exploring various types of operating systems on a physical or logical (virtual) machine

1. Write C programs to implement UNIX system calls and file management system calls.
2. Write C programs to demonstrate various process related concepts.
3. Write C programs to demonstrate various thread related concepts.
4. Write C programs to simulate CPU scheduling algorithms: FCFS, SJF, Round Robin.

5. Write C programs to simulate Intra & Inter-Process Communication (IPC) techniques: Pipes, Messages Queues, Shared Memory.
6. Write C programs to simulate solutions to Classical Process Synchronization Problems: Dining Philosophers, Producer-Consumer, Readers-Writers
7. Write a C program to simulate Bankers Algorithm for Deadlock Avoidance.
8. Write C programs to simulate Page Replacement Algorithms: FIFO, LRU
9. Write C programs to simulate implementation of Disk Scheduling Algorithms: FCFS, SSTF.
10. Shell programming: creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).

Course Code	Course Title						Core/Elective
1PC456AD	JAVA PROGRAMMING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	4	40	60	2

COURSE OBJECTIVES :

1. To implement various java concepts.
2. To write java programs to solve mathematics, science and engineering problems.
3. To identify compile time and runtime errors, syntax and logical errors.
4. To import the essentials of java class library and user defined packages.
5. To develop skills in internet programming using applets and swings.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. To understand the use of OOPs concepts.
2. Develop Java program using packages, inheritance and interface.
3. Develop java programs to implement error handling techniques using exception handling.
4. Develop graphical user interface using AWT.
5. Demonstrate event handling mechanism.

List of Programs

1. Implement the concept of classes and objects.
2. Implement Arrays to a given application.
3. Use String and String Tokenizer classes and develop a java programs.
4. Develop a java programs Using interfaces and packages.
5. Develop Java Programs using inheritance.
6. Develop Java programs using Method overloading and method overriding.
7. Develop java programs using Exception handling (using try, catch, throw, throws and finally).
8. Develop java programs using Multithreading (using Thread class and Runnable interface, synchronization).
9. Develop java programs using collections (using list, set, Map and generics).
10. CASE STUDY: Develop a program to calculate SGPA & CGPA of a student and display the progress report.

INPUT :

INPUT		
ROLL NO	NAME	HOW MANY SEMESTERS? Semester wise : Subject Code, Subject Name And Marks

OUTPUT :

Progress report of <NAME>

Roll No:

Program(BE/ME)

Branch:

College Code and Name:

Year of joining:

Semester-I Grades	**Semester-II Grades**	**Semester-III Grades**
Subject 1:	Subject 1:	Subject 1:
Subject 2:	Subject 2:	Subject 2:
Subject 3:	Subject 3:	Subject 3:
….	….	….
SGPA :	SGPA :	SGPA :
CGPA :	CGPA :	CGPA :

Note : The above experiments can be implemented using any IDE.

Course Code	Course Title						Core/Elective
1PC457AD	STATISTICAL ANALYSIS AND COMPUTING USING PYTHON LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. Install Numpy and Pandas.
2. Work with 1D and 2D array in Numpy.
3. Explore multi-dimensional arrays in Numpy.
4. Perform statistical analysis using Numpy.
5. Perform statistical analysis using Pandas.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Install Numpy and Pandas.
2. Work with 1D and 2D array in Numpy and process data in arrays.
3. Explore multi-dimensional arrays in Numpy and perform conversions.
4. Perform statistical analysis using Numpy by calculating measures od central tendency, deviation, distances and correlation.
5. Perform statistical analysis using Pandas.

List of Programs

1. Installing Numpy.
2. Working with arrays.
   a. Create a 1D array.
   b. Create a boolean array.
   c. Extract items that satisfy a given condition from 1D array.
   d. Replace items that satisfy a condition with another value in numpy array.
   e. Replace items that satisfy a condition without affecting the original array.
   f. Reshape an array.
   g. Extract all numbers between a given range from a numpy array.

3. Multiple arrays
    a. Stack two arrays vertically
    b. Stack two arrays horizontally
    c. Get the common items between two python numpy arrays
    d. Remove from one array those items that exist in another
    e. Get the positions where elements of two arrays match
4. Multi-dimensional arrays
    a. Convert an array of arrays into a flat 1d array
    b. Swap two columns in a 2d numpy array
5. Statistical analysis
    a. Compute the mean, median, standard deviation of a numpy array
    b. Find the percentile scores of a numpy array
    c. compute the euclidean distance between two arrays
    d. Find the correlation between two columns of a numpy array
    e. Probabilistic sampling in numpy
    f. compute the moving average of a numpy array
6. Data Cleaning
    a. Find the position of missing values in numpy array
    b. Drop rows that contain a missing value from a numpy array
    c. Replace all missing values with 0 in a numpy array
    d. Drop all missing values from a numpy array
7. Data Transformation
    a. Normalize an array so the values range exactly between 0 and 1
    b. Compute the min-by-max for each row for a numpy array 2d
8. Pandas Basics
    a. Installing Pandas
    b. Import pandas and check the version
    c. Create a series from a list, numpy array and dict
    d. Convert the index of a series into a column of a dataframe
    e. Combine many series to form a dataframe
9. Statistical analysis in pandas
    a. Get the minimum, 25th percentile, median, 75th, and max of a numeric series
    b. Get frequency counts of unique items of a series
    c. Bin a numeric series to 10 groups of equal size
    d. Compute the euclidean distance between two series
10. Data Preparation in pandas
    a. Normalize all columns in a dataframe
    b. Compute the correlation of each row with the suceeding row
    c. Compute the autocorrelations of a numeric series

SKILL DEVELOPMENT COURSE-II

Semester IV	**L**	**T**	**P**	**Credits**
Subject code – 1PW458AD	0	0	2	1

Guidelines for Evaluation of Skill Development

1. Continuous Evaluation method is adopted for skill development courses of all semesters and 40 marks are allocated for CIE.

   At the end of each module, the student isevaluated by allocating marks as given under.

   Observation- 10 marks

   Continuous Performance and Execution -20 marks

   Viva-Voce—10marks

   Average of marks obtained in all experiments is considered as the marksobtained in CIE

2. The Semester End Examination shall be conducted with an external examiner and the internal examiner for 60 marks. The external examiner shall be appointed by the Principal from the panel of examiners recommended by Controller of Evaluation andBoard of Studies.

   Quiz/ Skill Test/Assignment/ Mini Project– 40 marks

   Viva-voce-20 marks

Course Code	Course Title						Core/Elective
1PW458AD	CISCO CCNA MODULE I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. Explain the advances in modern network technologies, configure IP address, passwords etc
2. Explain how network protocols enable devices to access local and remote network resources
3. Explain how routers use network layer protocols and services to enable end-to-end connectivity
4. Implement IPv4 and IPv6 addressing scheme
5. Configure a switch port to be assigned to a VLAN based on requirements.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Build simple LANs, perform basic configurations for routers and switches,
2. Implement IPv4 and IPv6 addressing schemes.
3. Implement VLANs and trunking in a switched network
4. Implement DHCPv4 to operate across multiple LANs and explain how WLANs enable network connectivity.
5. Develop critical thinking and problem-solving skills using real equipment and Cisco Packet Tracer.

MODULE - I:

Networking today: Network Affect our Lives, Network Components, Network topologies, Types of Networks

Basic Switch and End Device Configuration: IOS Access, Command Structure, basic device configuration, Ports and addresses, configuring IP address, protocols and models.

MODULE - II :

Physical Layer : Introduction to cables, Number Systems.

Data Link Layer : Topologies, Data Link frame

Ethernet Switching : Ethernet Frame, MAC Address Table

MODULE - III :

Network layer : IPv4 and IPv6 packet , addressing of IPv4 and IPv6

Address Resolution : MAC & IP, ARP, IPv6 Neighbour Discovery.

MODULE - IV :

ICMP, Transport layer : TCP & UDP

Application Layer : Web and email protocols, IP Addressing Services.

MODULE - V :

Network Security Fundamentals : Network Attacks, Device Security.

REFERENCES

CCNA ROUTING & SWITCHING BY CISCO PRESS.