S. B. JAIN INSTITUTE OF TECHNOLOGY, MANAGEMENT & RESEARCH, NAGPUR.
(An Autonomous Institute, Affiliated to RTMNU, Nagpur)
DEPARTMENT OF EMERGING TECHNOLOGIES (AI&ML and AI&DS)

COURSE SYLLABUS

FOR

SEMESTER – III

B. Tech.

ARTIFICIAL INTELLIGENCE (AI) AND DATA SCIENCE

(W. E. F. 2022-23)

S. B. JAIN INSTITUTE OF TECHNOLOGY, MANAGEMENT & RESEARCH, NAGPUR.

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DEPARTMENT OF EMERGING TECHNOLOGIES (AI&ML and AI&DS)

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD301T	Fundamentals of Digital Electronics and Computer Architecture	3	0	0	3	40	60	100	3

Course Objective
The course develops the logic for designing digital circuits, functional units of computer architecture and ability to improve performance of machine that enhances employability and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Simplify the Boolean functions using Boolean algebra and K-maps to develop combinational circuits for input signals.
CO2	**Analyze:** Analyze the concepts of sequential circuits to design bit cells using flip-flops.
CO3	**Apply:** Make use of basic operational concepts of computer architecture and utilize computer arithmetic to perform various operations.
CO4	**Apply:** Apply the knowledge of memory, I/O organization and pipelining for efficient peripheral communication and improving the performance of a system.
CO5	**Analyze:** Analyze the improvement in performance of the system by using different types of memory and I/O devices.

SYLLABUS

UNIT I: Fundamental Concepts of Digital Systems

Introduction, number systems, logic gates and truth tables, minimization of combinational circuits using Boolean algebra, Karnaugh maps.

Exposure of modern simulator for demonstrating logic gates.

UNIT II: Combinational Circuits

Adders & subtractor (half & full), multiplexers, demultiplexers, encoders, decoders, code converters and their use in realizing Boolean functions.

Exposure of modern simulator for demonstrating combinational circuits.

UNIT III: Sequential Circuits

Flip-flops (FF): D, T, J-K, S-R, Master Slave (MS) J-K flip-flops, conversion of one FF to another FF, introduction of counters and registers as applications of flip-flops.

Exposure of modern simulator for demonstrating sequential circuits.

UNIT IV: Basic Computer Structure and Arithmetic

Basic structure of computers: Von Neumann vs. Harvard architecture, functional units, basic operational concepts, bus structures, instruction formats, addressing modes, execution of complete instructions, subroutines, hardwired and microprogrammed control.

Computer arithmetic: Introduction, addition and subtraction, Booth's multiplication algorithm, restoring and non-restoring division algorithms, floating point representation.

UNIT V: Memory & I/O Organization

Memory organization: Memory hierarchy, RAM, ROM and cache memory, memory mapping techniques, virtual memory, page replacement policies.

Input-output organization: Peripheral devices, input-output interface, modes of transfer, interrupts, direct memory access.

UNIT VI: Central Processing Unit

Central processing unit: The 8086 processor architecture, register organization, physical memory organization, general bus operation, concept of pipelining.

Text Books
1. Modern Digital Electronics, R. P. Jain, 4th Edition, 2010, McGraw Hill.
2. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5th Edition, 2011, International Edition.
3. Advanced Microprocessors and Peripherals, K. M. Bhurchandi, A. K Ray, 3rd Edition, 2017, TMH.

Reference Books
1. Modern Digital Electronics, R. P. Jain, 4th Edition, 2010, McGraw Hill.
2. Microprocessors and Interfacing, D. V. Hall, SSSP Rao, 3rd Edition, 2006, Tata McGraw Hill.
3. Computer System Architecture, M. Morris Mano, 3rd Edition (Revised), 2017, Pearson.
4. Modern Computer Architecture and Organization: Learn X86, ARM, and RISC-V Architectures and the Design of Smartphones, PCs, and Cloud Servers, Jim Ledin, 1st Edition, 2020, Packt Publishing Ltd.

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Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD302T	Data Structures & Algorithms	3	0	0	3	40	60	100	3

Course Objective
The course develops programming skills to analyze linear and non-linear data structures and strengthen the ability to apply suitable data structure for the given real-world problem that helps to enhance employability.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Analyze:** Classify the appropriate abstract data type and analyze the efficiency of an algorithm based on time and space complexity.
CO2	**Apply:** Select the appropriate searching and sorting techniques to solve given problems.
CO3	**Create:** Design an algorithm using linear and nonlinear data structures to solve engineering problems.
CO4	**Create:** Design an appropriate hashing function for indexing large storage in different applications.
CO5	**Apply:** Demonstrate and apply appropriate data structure to solve given problems.

SYLLABUS

UNIT I: Abstract Data Types and Algorithms

Introduction: Basic terminologies, abstract data types (ADT) and their characteristics, concept of linear and nonlinear, static and dynamic.

Algorithms: Introduction to algorithms, characteristics of algorithms, analysis of algorithms, complexity of algorithms: space complexity, time complexity, asymptotic notations: Big-O, Theta and Omega.

UNIT II: Sorting and Searching

Sorting: Types- Internal and external sorting, general sorting concepts - sort order, stability, efficiency, number of passes, sorting methods - merge sort, quick sort, heap sort, shell sort, bucket sort, radix sort, application of sorting techniques, performance analysis and comparison.

Searching: Linear Search, binary search, applications of searching, performance analysis and comparison, application of fibonacci search in non-uniform access memory storage.

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UNIT III: Stacks and Queues

Stack ADT: Concept, primitive operations, implementation of stacks, multiple stacks, applications of stack, need for prefix and postfix expressions, conversion from infix to prefix and postfix expression, evaluation of prefix and postfix expression using stack.

Queue ADT: Concept, operations, simple queue, circular queue, double-ended and priority queue, applications of queue.

UNIT IV: Linked Lists

Concept, primitive operations, representation of linked lists, types of linked list- singly linked list, circular linked list and doubly linked list, polynomial manipulations: addition and multiplication using linked list, generalized linked list (GLL).

UNIT V: Trees

Basic Tree terminologies, tree definition and properties, binary tree and its operations, binary search tree (BST) and its operations, threaded binary trees, AVL tree and its rotation, red black tree, splay tree, B-tree, B+ tree, tree traversal techniques, applications of tree traversal techniques.

UNIT VI: Graphs and Hashing

Graphs: Introduction to Graphs, applications of graph, representation of graphs, traversals techniques-BFS and DFS.

Hashing: Hash functions and hash tables, properties, simple hash function, methods for collision handling

Text Books

1. Fundamentals of Data Structures in C, Ellis Horowitz, Sartaj Sahani & Susan Anderson-Freed, 2nd Edition, 2012, Universities Press.
3. Data Structures and Algorithms: Concepts, Techniques and Application, G.A.V. Pai, 3rd Edition, 2012, Tata McGraw-Hill Education.

Reference Books

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, 3rd Edition, 2017, Pearson Education.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, 3rd Edition, 2015, MIT Press.
3. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg & Behrouz A. Forouzan, 2nd Edition, 2004, Course Technology Inc.

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Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD302P	Data Structures & Algorithms Lab	0	0	2	1	25	25	50	-

Course Objectives
The course develops programming skills to analyze and apply linear and non-linear data structures to solve real-world problems that enhances employability.

Course Outcomes	
After successful completion of this course the students will be able to:	
CO1	**Analyze:** Analyze the performance of various algorithms based on time and space complexity.
CO2	**Apply:** Apply appropriate searching and sorting techniques for a given problem statement.
CO3	**Create:** Design applications using linear and nonlinear data structures to solve engineering problems.
CO4	**Evaluate**: Choose appropriate data structures to solve given problems efficiently.

A minimum of eight practical to be performed based on the theory course Data Structures and Algorithms [PCCAD302T].

Suggested References
1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 3rd Edition, 2015, PHI Learning.
2. Data Structures using C, K. Sharma, 2nd Edition, 2013, Pearson Education.
3. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg & Behrouz A. Forouzan, 2nd Edition, 2004, Course Technology Inc.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD303T	Computer Networks	3	0	0	3	40	60	100	3

Course Objective
Gain valuable skills in computer network system, various protocols, network administration, modern technology and their applications to develop entrepreneurship skills and start-ups.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Apply the knowledge of analog and digital signals, transmission modes, signal conversion techniques in data communication.
CO2	**Apply:** Select suitable routing protocol and congestion control mechanism to improve quality of service.
CO3	**Analyze:** Analyze layer wise functioning of network architecture with different performance measures in communication networks.
CO4	**Evaluate:** Evaluate the design issues of the data link layer using various techniques and protocols.
CO5	**Understand:** Demonstrate the knowledge of modern network technologies used in network communication.

SYLLABUS

UNIT-I: Data Communication Basics

Process of data communication and its components: transmitter, receiver, medium, message, protocol, bandwidth, data transmission rate, analog and digital signals, Transmission modes: serial and parallel transmission, asynchronous and synchronous transmission, simplex, half-duplex and full-duplex communication, transmission media, switching techniques, circuit switching and packet switching.

UNIT-II: Introduction to Computer Networks

Introduction, network criteria, network topology, networking devices, categories of networks (LAN, MAN, WAN), wireless network (Bluetooth, Wi-Fi, WiMAX, Zigbee, Wi-Fi SON. Reference models: OSI reference model, TCP/IP model, comparison of models.

Use of modern simulator to demonstrate the categories of networks.

UNIT-III: Data Link Layer

Types of errors, framing: character and bit stuffing, error detection & correction methods. Flow control protocols: stop & wait ARQ, Go-Back- N ARQ, selective repeat ARQ, point to point protocol, Fiber Distributed Data Interface (FDDI), token bus, token ring. Multiple access protocols: random access, controlled access, channelization techniques.

Use of modern simulators to demonstrate the concept of flow control protocols

UNIT-IV: Routing Protocols

Routing: adaptive and non-adaptive techniques, static vs dynamic routing, routing table. Routing algorithms: shortest path algorithm, flooding, distance vector routing. Mobile routing algorithms: Destination Sequenced Distance Vector (DSDV) and Dynamic Source Routing (DSR), concept of wireless router.

Use of modern Simulator to demonstrate the routing algorithms.

UNIT-V: Network and Transport Layer

Network Layer: ARP, RARP, IP, DHCP, ICMP, IPV6, unicast and multicast routing protocols. Congestion control algorithms: leaky bucket algorithm, token bucket algorithm, congestion control techniques.

Transport Layer: Process to process delivery, UDP, TCP, Quality of Service (QoS).

UNIT-VI: Application Layer

Application Layer: Domain Name System (DNS), Dynamic Domain Name System (DDNS), telnet, email, File Transfer Protocol (FTP), www, Hyper Text Transfer Protocol (HTTP), Simple Network Management Protocol (SNMP), Bluetooth, Firewalls.

Text Books

1. Data Communications and Networks, Behrouz A. Forouzan, 5th Edition, 2013, Tata McGraw- Hill Publication.
2. Computer Networks, Andrew S. Tanenbaum, 5th Edition, 2011, Prentice – Hall India.

Reference Books

1. Data and Computer Communication, William Stallings, 8th Edition, 2012, Pearson Education.
2. Data Communications and Computer Networks, Dr. T. Sreenivasulu, Dr. H. Shaheen, Dr. Rajasekar Rangasamy, 2018, VSRD Academic Publishing
3. Computer Networks and Internets: With Internet Applications, Dougles E Comer and M.S. Narayanan, Vol. 1, 4th Edition, 2008, Pearson Education.
4. Computer Networks: A Systems Approach, Larry L. Peterson and Bruce S. Davie, 5th Edition, 2012, Morgan Kauffmann Publishers.

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Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD303P	Computer Networks Lab	0	0	2	1	25	25	50	--

Course Objectives
Gain valuable skills in computer network system, various protocols, network administration, modern technology and their applications to enhance entrepreneurship skills and promote start-ups.

Course Outcomes	
After successful completion of this course the students will be able to:	
CO1	**Apply:** Use various network utility commands for checking the internet connectivity and the concepts of IPv4 addressing for assigning IP addresses to network machines.
CO2	**Apply:** Apply network fundamentals to solve computational problems and estimate the performance to improve quality of service in computer networks.
CO3	**Evaluate:** Evaluate the network performance with different routing algorithms.
CO4	**Design:** Design of LAN using various wired, wireless networking devices & network cables to simulate networking scenarios.

A minimum of eight practical to be performed based on the theory course Computer Networks [PCCAD303T].

Suggested References:

1. Data Communications and Networks, Behrouz A. Forouzan, 5th Edition, 2013, Tata McGraw- Hill Publication.
2. Computer Networks, Andrew S. Tanenbaum, 5th Edition, 2011, Prentice – Hall India.
3. Data and Computer Communication William Stallings, 8th Edition, 2012, Pearson Education.

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Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE Duration (Hrs.)
		L	T	P		Continual Evaluation	End Sem Exam	Total	
PCCAD304T	Database Management System	3	0	0	3	40	60	100	3

Course Objective
The course empowers the learners to apply the concepts of traditional and modern database management systems to design and handle databases that enhances their development skills and employability.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Interpret the fundamental and advanced concepts in the database to comprehend various database architectures.
CO2	**Apply:** Make use of SQL, PL/SQL and NoSQL to perform different operations on database as per specified problem statement.
CO3	**Apply:** Apply the concept of relational data model, integrity constraints, query processing, transaction management, indexing and normalization on database to solve given problem.
CO4	**Analyze:** Analyze different database techniques to design efficient databases in different scenarios.
CO5	**Create:** Design an appropriate ER diagram and respective database for given application.

SYLLABUS

UNIT-I: Introduction to Database

Overview of Database Management Systems, Purpose, Limitations of File Processing System, Industrial Applications, Data Models, Types of Databases, Database Users, DBA, Data Abstraction, View, Data Independence, DBMS Architecture, Three Tier architecture, Keys

ER Model: Entity, Attributes, Relationships, ER Diagram, Weak & Strong Entity, Extended E-R Features, Database Development Life Cycle, Approaches to Building a Database, Challenges in Building a DBMS

Exposure to open-source tool for designing ER Diagrams

UNIT-II: SQL AND PL/SQL

SQL: Characteristics and advantages, SQL Data Types, DDL, DML, SQL Operators, order by, distinct, like, in, between, all, any, joins, set operations, aggregate functions, group by clause, having clause, Sub queries, alias, sequence, handling null values, CASE, single row functions. DCL, TCL

PL/SQL: Constant, variables, Operators, Control Structures, Loops, Procedures, Functions and Cursors, Triggers, Packages

Exposure to LiveSQL to demonstrate SQL & PL/SQL

UNIT-III: Relational Data Model

Concept of relations, Schema-instance distinction, CODD's Rules. Relational Algebra: Unary and Binary Operators. Relational Calculus: Tuple relational calculus, Domain relational calculus

Integrity Constraints: Domain Constraints, Referential Integrity, Assertions and Triggers

Exposure to LiveSQL for demonstration of Integrity Constraints

UNIT-IV: Relational Database Design

Introduction to Indexing: Advantages, Evaluation Metrics, Types: Primary Indexing, Dense, Sparse, Clustering Index, Multi-Level, Secondary

Normalization: Concepts of Functional dependency, Decomposition, closure of FD set, closure of attributes, 1NF, 2NF, 3NF, BCNF, 4NF, 5NF

UNIT-V: Query Processing & Transaction Management

Query Processing: Steps in Query Processing, Pipelining and Materialization, Query optimization types, Materialized View

Transaction Management: Basic concept of a Transaction, ACID Properties of Transactions, Concept of Schedule: Serial & Non-serial, Serializability: Conflict and View

UNIT-VI: Concurrency Control & Recovery System

Concurrency Control: Lock-based and timestamp-based protocols, Deadlock: Deadlock handling, detection and recovery

Recovery System: Failure classification, Log-Based Recovery, Shadow-Paging, Aries Algorithm, Checkpoints, Introduction to Advanced Concepts in Databases

Text Books

1. Database System Concepts, Silberschatz A., Korth H., Sudarshan S., 7th edition, 2019, Tata McGraw Hill.
2. SQL, PL/SQL: The Programming Language of Oracle, Ivan Bayross, 4th Revised Edition, 2020, BPB Publication.

Reference Books

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, 3rd Edition, 2014, Tata McGraw Hill Publication.
2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant Navathe, 7th Edition, 2016, Pearson.
3. An Introduction to Database Systems, C J Date, 8th Edition, 2004, Pearson.
4. NoSQL Distilled, Pramod J. Sadalage, Martin Fowler, 1st Edition, 2002, Addison Wesley.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continual Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD304P	Database Management System Lab	0	0	4	2	25	25	50	-

Course Objective
The course empowers the learner to apply the concepts of traditional and modern database management systems to design and handle databases that enhances their development skills and employability.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Create:** Design an appropriate ER Diagram for a given problem by using different Open - Source tools.
CO2	**Create:** Design, develop and modify the databases for any real-world problem using suitable queries.
CO3	**Apply:** Construct SQL query for given problem statement using suitable SQL clause to retrieve data from database.
CO4	**Apply:** Build connection between frontend and backend using appropriate procedure.
CO5	**Create:** Develop a PL/SQL block to provide solutions for real world problems.

A minimum of eight practical to be performed based on the theory course Database Management System [PCCAD304T].

Suggested References

1. SQL: The Complete Reference, James Groff, Paul Weinberg, Andy Oppel, 3rd Edition, 2017, McGraw Hill.
2. SQL, PL/SQL: The Programming Language of Oracle, Ivan Bayross, 2010, BPB Publication.
3. MongoDB: The Definitive Guide, Kristina Chodorow, Michael Dirolf, 2019, O'Reilly Publications.

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Course Code	Course Title	Hour/ Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD305P	Python Programming Lab	0	0	4	2	25	25	50	--

Course Objective
The course familiarizes the prospective engineers with fundamentals of Python Programming language, numpy library, panda library and Django web framework in order to enhance their skills, employability and explore entrepreneurship ideas.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Apply:** Apply knowledge of Python Scripting, control structure, string and functions to solve the given problems effectively.
CO2	**Apply:** Utilize concepts of numpy, data structures, files and data frames to develop efficient solution for the given problems.
CO3	**Analysis:** Analyze the problems using knowledge of object-oriented programming and Exception handling to develop useful applications.
CO4	**Evaluate:** Select appropriate libraries and modules available in python programming to solve the given problem efficiently.
CO5	**Create:** Design and Develop solutions using Python libraries and Web framework for the given problem statement.

SYLLABUS

MODULE-I: Fundamentals of Python Programming

Python Scripting: Introduction to Python, Installation, Python IDLE, Scripting using Google Colab.
Python Basics: Data Types, Keywords, Variables, Operators, Expressions, Scope of variables and input () Function
Control Structure: If statement, If-else statement, If-elif-else, For Loop, Iterating Over a Range, While Loop, Else clause in Loop, Nesting of Loops.
Introduction to Numpy: Need of Numpy, Features, Creating Arrays, Array Indexing, Numpy Array operations.

Exposure to Sublime Text for learning Python.

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MODULE-II: String and Functions

Strings in Python: Creating string, Character Extraction from String, Iterating Over Strings, String Slicing, Modify string, Concatenate String and String operations.

Python Function: Defining a Function, Calling a Function, Pass by reference vs value, Types of Function Arguments, Anonymous Function and Recursion.

Exposure to Pycharm IDE

MODULE-III: Data Structures

List in Python: Creation, iterating List, List slicing, Appending a list and List operations.

Tuple in Python: Understanding tuple, Iterating over tuple, Slicing, Indexing and Tuple methods.

Set in Python: Understanding set, Iterating over set and Set operations.

Dictionary in Python: Understating Dictionary, Iterating over dictionary, Indexing, Dictionary operations, Comparison among List, Tuple, Set and Dictionary.

Exposure to Spyder IDE

MODULE-IV: File Handling and Dataframes

File Handling: Introduction to files, file Object Attributes, File operations: open( ), close( ), read(), write( ), rename(), remove(), Positioning, Copying, Merging and Appending.

Data frames in Python: Introduction to Pandas, Data import, Data Export, Data Processing using Pandas.

Exposure to Jupyter Notebook

MODULE-V: Object Oriented Programming and Exceptions Handling

Object Orientated Programming: Classes, Objects, Attributes, Accessing attribute, Instantiation, Methods, Calling methods and Inheritance, Methods and Operator Overloading.

Exception Handling: Syntax Error, Exceptions, try clause, except clause, raise clauses, Handling and Raising an Exceptions.

Exposure to VSCode

MODULE-VI: Web Framework

Introduction of Django: Need of framework, Feature of Django Framework

Project Set-Up: Django Installation, Create Django Project, Virtual Environment Set Up, Explanation of different Configuration File

URL Mapping: Handle Request and Response, Handle static file.
Deployment of web application.

A minimum of eight practical to be performed based on above modules.

Suggested References

1. Learning Python, Mark Lutz, 4th Edition, 2000, O'Reilly Media.
2. Python Data Science Handbook, Jake Vaderplas, 1st Edition, 2016, O'Reilly Media.
3. Django for APIs: Build web APIs with Python and Django, William S Vincent, 2018, Kindle Edition.
4. Python: The complete Reference, Martin C Brown, 1st Edition, 2001, McGraw Hill.
5. Python Essential Reference, 4th Edition, 1999, Developer's Library.

21/07/22
Dr. M S Nimbarte

Dr. R. Jain
21/7/22

S. A. Ambhore
21/7/2022

Md. Ashan

21/7/22

Dr. S. S. Badhiye

21/07/22
Dr. Richa Makhijani

S. R. Pradhan

21/7/22
A. R. Tayade

Shruti Jain

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"Become an excellent center for Emerging Technologies in Computer Science to create competent professionals"

COURSE SYLLABUS

FOR

SEMESTER – IV

B. Tech.

ARTIFICIAL INTELLIGENCE (AI) AND DATA SCIENCE

(W. E. F. 2022-23)

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem.	Total	Duration (Hrs.)
PCCAD401T	Discrete Mathematics and Graph Theory	3	1	0	4	40	60	100	3

Course Objective

The course provides the concepts such as logic and proofs, sets and functions, probability, group theory, graph theory, ring theory and other important discrete mathematical concepts to the learners.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	**Evaluate**: Identify the axioms of set theory, formulate the problem in the language of sets and perform set operations to solve them.
CO2	**Apply**: Apply the various types & properties of Relations & Functions to solve real world problems.
CO3	**Apply**: Apply the theorems on group theory & ring theory to solve problems and analyze the structures.
CO4	**Apply**: Apply the concept of graph theory and trees to solve real world problems.
CO5	**Apply**: Apply basic counting techniques to solve combinatorial problems.

SYLLABUS

UNIT 1: Mathematical Logic

Propositions and Logical Operations, Quantifiers, Conditional Statements and Tautologies, Methods of Proof, Principle of Mathematical Induction. Basic concepts of set theory, Operations on Sets, The power set.

UNIT 2: Relation and Functions

Relations: Ordered pairs, Product Sets and Partitions, Relations and Digraphs, Matrix of Relation, Properties of Relations, Equivalence Relations, Compatible Relation, Composition of Relations, Transitive Closure of a relation, Partial order relation, Hasse Diagrams.

Functions: Definition, Composition of functions, Types of Functions, Invertible Function, Permutation Function, Characteristics function of a set with Theorems.

UNIT 3: Group Theory

Binary Operations, Properties, Semi groups, Monoids, Isomorphism & Homomorphism, Groups (only definitions and examples) Subgroups and Homomorphism, Co sets and Lagrange's Theorem, Normal subgroups.

UNIT 4: Ring Theory

Rings, Fields, Integral Domain, Ring Homomorphism (definitions & examples),

Lattices: Properties, Types of Lattices, Sub lattices, Isomorphic Lattices, Complemented & Modular Lattices (definitions & examples).

Optimization using Linear Programming Problems.

UNIT 5: Graph Theory Basic concepts of Graph Theory, Digraphs, Basic definitions, Paths and Circuits, Reachability and Connectedness, Matrix representation of graphs, Sub graphs, Isomorphic digraphs, Euler's and Hamilton Path & Circuit (only definitions and examples). **Trees**: Binary Tree, Labeled Trees, Undirected Trees, Spanning Trees of Connected Relations, Minimal Spanning Trees by Prim's Algorithm & Kruskal's Algorithm.
UNIT 6: Combinatorics Generating Functions, Recurrence Relations, **Counting**: Permutations & Combinations, Pigeonhole Principle with Simple Applications

Text Books:
1. Discrete Mathematical Structures, Kolman, Busby & Ross, 6th Edition, 2019, PHI Publication.
2. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Kenneth H. Rosen's, 7th Edition 2011, McGraw-Hill Publishing.
3. Discrete Mathematical Structures with Applications to Computer Science, Tremblay & Manohar, 35th Edition, 1997, Tata McGraw- Hill.

Reference Books:
1. Discrete Mathematics for Computer Scientists & Mathematicians, Mott, Kandel, Baker, 2nd Edition, 2018, Pearson Publication.
2. Elements of Discrete Mathematics, C.L. Liu, 3rd Edition, 1969, McGraw Hill
3. Discrete Mathematics by Lipchitz & Lipson, 3rd Edition, 2007, Schaum's Series.
4. Discrete Mathematics, R. Johnsonbaugh, 8th Edition, 2013, Pearson Publication.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem.	Total	Duration (Hrs.)
PCCAD402T	Operating System	4	0	0	4	40	60	100	3

Course Objective

The course empowers the learners with the fundamentals of Operating System, its design & development issues such as process scheduling, synchronization, deadlocks, memory management, I/O subsystems and protection to enhance their technical skills and employability.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	**Understand:** Interpret the concepts of operating systems to deal with computer hardware using its fundamental concepts.
CO2	**Apply:** Utilize the concept of process management, synchronization and memory management in designing operating systems to resolve different issues.
CO3	**Apply:** Apply various disk scheduling algorithms and concepts of system security for file management related problems.
CO4	**Analyze:** Analyze process scheduling, synchronization problems and memory management techniques under various situations to improve system performance.
CO5	**Analyze:** Examine the given scenario using the concepts of deadlock, system security, files and disk scheduling algorithms to solve the real-world problems.

SYLLABUS

UNIT I: Introduction to Operating System

Concepts and Generations of Operating systems, Services, Components, Types of Operating Systems, System Calls, Structure of an OS - Layered, Monolithic, Microkernel OS, Basic h/w support necessary for modern operating systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Exposure to Android Studio and VMware specialized Operating Systems.

UNIT II: Process Management

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

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria. Scheduling algorithms: Preemptive and Non-Pre-emptive, FCFS, SJF, RR, Priority Scheduling, Real Time scheduling: RM and EDF.

Inter process Communication: Message Passing, Shared Memory.

UNIT III: Process Synchronization

Thread: Definition, Various states, Multithreading: Benefits of threads, Concept of multi-threads,

Multithreading Models.

Critical Section problem: Introduction, Race Condition, software and hardware solution, Peterson's solution, Semaphores, Monitors.

Classical Synchronization Problems: Bounded Buffer, Reader's & Writer Problem, Dining Philosopher Problem.

UNIT IV: Deadlock & Protection

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Resource allocation graph, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of Access matrix, Security problem.

UNIT V: Memory Management

Basic concept, Logical and Physical address, Memory allocation: Contiguous Memory allocation, Fixed and variable partition, Internal and External fragmentation, Compaction, Swapping, Segmentation.

Paging: Principle of operation, Page allocation, Hardware support for paging, Page table structuring technique, Protection and sharing, Advantages and Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory, Demand paging, Page fault, Working Set, Dirty page/Dirty bit, Page Replacement algorithms: Optimal, First in First Out (FIFO) and Least Recently used (LRU), Thrashing.

UNIT VI: File System Management

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

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, Disk formatting, Boot-block, Bad block, I/O devices, Device controllers and Device drivers.

Introduction to Mobile and Smart OS: Architecture & Overview of Android OS. Comparison of different OS. Recent Trend, Global Operating System Market.

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, 2016, John Wiley & Sons.

Reference Books:

1. Modern Operating System, Andrew S. Tanenbaum, Herbert Bos, 4th Edition, 2015, Pearson Education.
2. Operating Systems Internals and Design Principles, William Stallings, 7th Edition, 2012, Pearson Education.
3. Operating Systems - A Concept-Based Approach, Dhananjay M. Dhamdhere, 3rd Edition, 2012, McGraw-Hill Education.
4. Operating Systems - Design Oriented Approach, Charles Crowley, 1st Edition, 2017, Mc. Graw Hill Education.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD403T	Object Oriented Programming	3	0	0	3	40	60	100	3

Course Objectives

The course enables the students to solve various programming problems, making use of object-oriented paradigm to simplify the design and implementation process to improve employability and technical skills.

Course Outcomes

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

CO1	**Analyze:** Identify classes, objects and members of a class and its relationships to solve a specific problem statement.
CO2	**Create:** Develop Java application programs using OOP principles, Java collection, java structuring, Multithreading & Exception Handling to solve real world problems.
CO3	**Evaluate:** Select Java API, appropriate Framework & technologies to solve the complex problems.
CO4	**Analyze:** Analyze the requirements to develop the software application using java programming.
CO5	**Create:** Develop a Java application using modern tools to solve societal problems.

SYLLABUS

UNIT-I: Introduction to OOP & Java

Object-oriented concepts, need of Java programming, basics of Java: history, features, paradigms, programming constructs, static modifier, final modifier, difference between Java & other languages like C and C++.

Fundamentals of Classes & Objects: Identify classes and objects in real word application, declaring objects, assigning objects, reference variables, overloading methods, constructors, 'this' keyword, wrapper classes. Applications: Object as a parameter, argument passing, command line arguments, returning object.

Nested classes: Inner classes, garbage collection, arrays.

Exposure to modern Integrated Development Environment (IDE's) used in industry.

UNIT-II: Java Strings and Packages

String: Immutable string, string comparison, string concatenation, searching string and modifying string, substring, stringbuffer class, stringbuilder class, tostring method, stringtokenizer class. Packages: Package fundamentals, access protection, importing packages.

UNIT-III: Inheritance & Exception handling

Inheritance: Types, abstract classes and methods, interfaces, method overriding.

Exception Handling: Exception types (checked, unchecked and uncaught exceptions), throw and throws keywords, creating user defined exceptions, built-in exceptions.

UNIT-IV: Multithreading

Fundamentals, Thread life cycle, ways of creating threads, creating multiple threads, isAlive(), join(), Thread synchronization, Thread priorities, inter Thread communication, methods for suspending, resuming and stopping threads.

Use of multithreading in game development and other applications in industry.

UNIT-V: Java Streams and Collections

Java Streams: Byte-oriented streams, character – oriented streams, reading and writing files, serialization. Collection Framework: Introduction, util package interfaces, List, Set, Map, List interface & its classes, Set interface & its classes, Map interface & its classes.

Use of modern data structures for the development of different applications.

UNIT-VI: Java 8 & Spring Boot

Java 8: Lambda expressions, method references, functional interfaces, stream API, forEach, Date/Time API, Java 8 security enhancements.

Spring boot: Definition, need, features of spring boot, web application development using spring boot to solve real world problems.

Text Books:

1. Object Oriented Programming in C++, E Balaguruswamy, 7th Edition, 2017, McGraw-Hill Education.
2. Java-The Complete Reference, Herbert Schildt, 9th Edition, 2014, Oracle Press.

Reference Books:

1. Java: A Beginners Guide, Herbert Schildt, 8th Edition, 2018, McGraw-Hill Education.
2. Programming with Java, E Balagurusamy, 6th Edition, 2019, McGraw-Hill Education.
3. The Java Language Specification, Bill Joy, Gilad Bracha, Guy L. Steele Jr., James Gosling, 10th Edition.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD403P	Object Oriented Programming Lab	0	0	2	1	25	25	50	--

Course Objectives
The course enables the students to create robust applications using Java's object-oriented features & Java class libraries to improve employability and technical skills.

Course Outcomes	
After successful completion of this course the students will be able to:	
CO1	**Apply:** Demonstrate practical applications developed in Java to solve complex problems.
CO2	**Apply:** Make use of exception handling, file I/O, multithreading, collection frameworks to develop java applications.
CO3	**Create:** Develop object-oriented programming concepts using basic syntax of control structures, strings and functions for logic building activities.
CO4	**Create:** Develop real world applications using Java collection API and Java class library to solve given use cases.
CO5	**Create:** Develop a Spring boot application using java programming.

A minimum of eight practical to be performed based on the theory course Object Oriented Programming [PCCAD403T].

Suggested References:
1. Java - The Complete Reference, Herbert Schildt, 9th Edition, 2014, Oracle Press.
2. Java: A Beginner's Guide, Herbert Schildt, 8th Edition, 2018, McGraw Hill Education
3. The Java Language Specification, Bill Joy, Gilad Bracha, Guy L. Steele Jr., James Gosling, 3rd Edition, 2005, Addison Wesley

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD404T	Fundamentals of Artificial Intelligence & Data Science	3	0	0	3	40	60	100	3

Course Objective
The course provides basic concepts of artificial intelligence and data science, handle various dataset in order to design applications of data science that enhances employability.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Illustrate the concepts of Artificial Intelligence and basics of Data Science, its trends and corresponding problems.
CO2	**Apply:** Apply exploratory search techniques to solve problems in various domains.
CO3	**Apply:** Make use of knowledge representation techniques to create a knowledge base for intelligent systems.
CO4	**Analyze:** Analyze the various aspects of data science and skill sets necessary for a data scientist.
CO5	**Apply:** Apply statistics and tools for Data Analysis in different scenarios.

SYLLABUS

UNIT I: Introduction to Artificial Intelligence

Definition of AI, history & applications, artificial intelligence as representation & search, intelligent agents, agent architecture, production system, basics of problem solving: AI techniques, problem representation paradigms, defining problem as a state space representation, problem characteristics.

UNIT II: Searching Techniques

Uninformed search techniques, informed heuristic-based search, Hill-climbing, Best-First search, AND graph, problem reduction, AND-OR graph algorithm, constraint satisfaction problem.

UNIT III: Knowledge Representation

Paradigms, propositional logic, inference rules in propositional logic, knowledge representation using predicate logic, first order logic, backward chaining and forward chaining, semantic net, frames, script, ontology.

UNIT IV: Basics of Data Science

Introduction to data science, relation of data science to other fields, data science and information science, computational thinking, skills and tools for data science, storing data, combining bytes into larger structures, creating data sets, identifying data problem, understanding data sources, exploring data models.

UNIT V: Data Handling Structured and unstructured data, challenges with unstructured data, data collection: open data and multimodal data, data preprocessing, data cleaning, data integration, data transformation, data reduction, data discretization.
UNIT VI: Statistical Inference Need of statistics in data science, measures of central tendency: mean, median, mode, mid-range. Measures of dispersion: range, variance, mean deviation, standard deviation. Bayes theorem, basics and need of hypothesis and hypothesis testing, Pearson correlation, sample hypothesis testing, Chi-square tests, T-test.

Text Books:
1. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig, 3rd Edition, 2009, Pearson Education.
2. An Introduction to Data Science, Jeffrey S. Saltz, Jeffrey M. Stanton, 2018, SAGE Publications

Reference Books:
1. Data Analysis Using Microsoft Excel, Ash Narayan Sah, 2009, Excel books
2. Data Science from Scratch, Joel Grus, 2015
3. Artificial Intelligence, Patrick Henny Winston, 3rd Edition, 1993, Pearson Education.
4. Artificial Intelligence by Example: Develop Machine Intelligence from Scratch Using Real Artificial Intelligence Use Cases, Denis Rothman, 2018, Packt Publishing Ltd.
5. A Hands-On Introduction to Data Science, Chirag Shah, 2020, Cambridge University Press

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD405P	Data Science Lab	0	0	2	1	25	25	50	-

Course Objective
The lab course develops technical skills to work with various python libraries for solving real-world problems that enhances the employability of the learners.

Course Outcomes	
After successful completion of this course the students will be able to:	
CO1	**Apply**: Make use of suitable python libraries as required for data preprocessing and analysis.
CO2	**Apply**: Apply the concepts of statistical-learning for scientific data processing using Sci-kit learn.
CO3	**Apply**: Make use of various tools of Matplotlib for data analysis and visualization.

MODULES	SYLLABUS
I	**Data Analysis using Scikit-learn** Installing scikit-learn, Scikit-learn governance and decision-making, statistical-learning for scientific data processing, Working with Text Data, Choosing the right estimator, Fitting and predicting: estimator basics, Transformers and pre-processors, Pipelines: chaining pre-processors and estimators, Model evaluation, Automatic parameter searches, Dataset transformations, Dataset loading utilities, Computing with scikit-learn.
II	**Data Analysis using Matplotlib** Introduction, Environment Setup, Pyplot, API Simple Plot, PyLab module, Object-oriented Interface, Figure Class, Axes Class, Multiplots, Subplots() Function, Subplot2grid() function, Grids , Formatting Axes, Setting Limits, Setting Ticks and Tick Labels, Twin Axes, Bar Plot, Histogram, Pie Chart Various type of Plots, Three-dimensional Plotting, 3D Contour Plot, 3D Wireframe plot, 3D Surface plot, Working With Text, Mathematical Expressions, Working with Images, transforms.

A minimum of eight practical to be performed based on the above modules.

Suggested References:
1. Data Analysis from Scratch with Python-Step by Step Guide, Peters Morgan, 2016, AI Sciences LLC.
2. Python Data Analytics - Data Analysis and Science Using Pandas, matplotlib, and the Python Programming Language, Fabio Nelli, 2015, Apress.
3. Matplotlib, tutorialspoint, (https://www.tutorialspoint.com/matplotlib/index.htm).

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continual Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD406P	Professional Skills Lab	0	0	4	2	25	25	50	--

Course Objective
The course provides students with the foundations necessary for understanding and extending the current state of the art in data visualization to increase their technical skill and employability.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Apply:** Apply data transformation techniques such as preprocessing, loading, modelling and categorizing the given data for visualization.
CO2	**Create:** Create different data visualizations that answers a particular research question using Spreadsheets, Power BI and Tableau to draw inferences for the given datasets.
CO3	**Create:** Design an effective dashboard using various techniques for real-time dataset.

MODULE	SYLLABUS
I	**Data Visualization using Spreadsheets** Spreadsheet Basics, Work with Cells and Worksheets, Calculate Your Data, format your Workbook, Add Charts and Graphics, create a new graph, add additional data series, Switch between rows and columns in source data, analyze data by using Quick Analysis, resize charts, Add and modify chart elements, apply chart layouts and styles, Move charts to a chart sheet
II	**Data Visualization using Power BI** Introduction to Power BI, installation of Power BI, advantages and disadvantages of Power BI, getting data from different data sources, Preprocess data (clean and transform data), Load data, Data modelling, Different visualization using Power BI, introduction to feature QnA from used data visualization.
III	**Data Visualization using Tableau** Introduction to Tableau, various products of tableau, installation of Tableau, Advantages and disadvantages of Tableau, Introduction to measures and dimensions. Categorizing data into measures and dimensions. Getting data from different data sources, Preprocess data (clean and transform data), Load data, Data modelling, Different visualization using Tableau, introduction to feature QnA from used data visualization.

A minimum of eight practical to be performed based on the above modules.

Suggested References:
1. Applied Microsoft Power BI, Teo Lachev, 2016, Prologika Press.
2. Power Query for Power BI and Excel, Chris Webb, Apress.
3. Practical Tableau - 100 Tips, Tutorials, And Strategies, Ryan Sleeper, 1st Edition, 2018, O'Reilly Media, Inc.
4. Communicating Data with Tableau, Ben Jones, 1st Edition, 2014, O'Reilly Media, Inc.
5. Beautiful Visualization, Julie Steele, Noah Iliinsky, 2010, O'Reilly Media, Inc.
6. Storytelling with Data - A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, 2015, John Wiley & Sons, Inc.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continual Evaluation	End Sem. Exam	Total	Duration (Hrs.)
OECAD401T	Data Visualization	3	0	0	3	40	60	100	3

Course Objective
The course provides basic knowledge about data visualization concepts and various tools that can be used to create visualization. This will help learners to prepare conceptual as well as practical foundation to increase their employability.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Understand the concepts of descriptive and inferential statistics, various graphs and their importance in data analysis process.
CO2	**Apply:** Apply the concepts of descriptive, inferential statistics and various graphs in data analysis process.
CO3	**Apply:** Apply data transformation techniques such as preprocessing, loading, modelling and categorizing the given data for visualization.
CO4	**Evaluate:** Evaluate and criticize data visualization based on the principles of analytic design.
CO5	**Create:** Create different data visualizations using Spreadsheets, Power BI and Tableau to draw inferences for the real-time datasets.

SYLLABUS
UNIT 1: Overview of Data and Descriptive statistics Overview of data, types of data and various analysis methods such as Exploratory, Descriptive, Inferential and Predictive. Introduction to descriptive statistics concepts such as summary statistics, Graph and their types and tables. Introduction to univariate, bivariate and multivariate analysis. Need of data visualization and type of visualization based on type of data.
UNIT 2: Overview of Inferential Statistics Introduction to Inferential Statistics and its type such as Hypothesis Tests, Confidence Interval and Regression. Implementation of various tests such as Correlation, ANOVA, Z test, T test, Comparison of descriptive and inferential statistics.
UNIT 3: Implementation of data Visualization using Spreadsheets Excel Basics, Work with Cells and Worksheets, Calculate Your Data, format your Workbook, Add Charts and Graphics, create a new graph, add additional data series, Switch between rows and columns in source data, analyze data by using Quick Analysis, resize charts, Add and modify chart elements, apply chart layouts and styles, Move charts to a chart sheet

UNIT 4: Data Visualization using Power BI Introduction to Power BI, installation of Power BI, Advantages and disadvantages of Power BI, getting data from different data sources, Preprocess data (clean and transform data), Load data, Data modelling, Different visualization using Power BI, introduction to feature QnA from used data visualization.
UNIT 5: Data Visualization using Tableau Introduction to Tableau, various products of tableau, installation of Tableau, Advantages and disadvantages of Tableau, Introduction to measures and dimensions. Categorizing data into measures and dimensions. Getting data from different data sources, Preprocess data (clean and transform data), Load data, Data modelling, Different visualization using Tableau, introduction to feature QnA from used data visualization.
UNIT 6: Dashboard Designing Introduction, Dashboard design issues and assessment of needs, Considerations for designing dashboard-visual perception, Achieving eloquence, Integration of different graphs.

Text Books:
1. Applied Microsoft Power BI, Teo Lachev, 2016, Prologika Press.
2. Power Query for Power BI and Excel, Chris Webb, Apress.
3. Practical Tableau - 100 Tips, Tutorials, And Strategies, Ryan Sleeper, 1st Edition, 2018, O'Reilly Media, Inc.

Reference Books:
1. Communicating Data with Tableau, Ben Jones, 1st Edition, 2014, O'Reilly Media, Inc.
2. Beautiful Visualization, Julie Steele, Noah Iliinsky, 2010, O'Reilly Media, Inc.
3. Storytelling with Data - A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, 2015, John Wiley & Sons, Inc.

03/09/22 Dr. M S Nimbarte

3/9/2022 (Sonali Lunke)

03/09/22 Dr. R. Jain

03/09/22

3/9/22 (Dr. A. Tayal)

3/9/22 (R. B. Talmale)

Bagde Pradeep 03/09/2022

Dr. S. S. Bedekar 03/09/2022

Md. Dohan

3/9/22 (Dr. Richa Malviya)

Dr. V. P. Balpande

3/9/22 Shweta Jain

CourseCode	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
HSMCME401P/ HSMCEE401P/ HSMCET401P/ HSMCCS402P/ HSMCAM401P/ HSMCAD401P/	Soft Skills-I	0	0	2	1	25	25	50	-

Course Objective

The course empowers the learner to develop and nurture soft skills so as to enhance their employability quotient.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	**Understand:** Assimilate the concept of soft skills in their professional career to nurture the Employability skills.
CO2	**Apply:** Apply grammatically correct structure in communication.
CO3	**Apply:** To build competency for presentation skills.
CO4	**Apply:** To make use of competency for professional correspondence.

Dr. S. Anwar

Dr. V. A. Sudani

SYLLABUS

MODULE 1: PROFESSIONAL READINESS ACQUISITION PROGRAM - (PRAP)

1. Importance of Soft Skills: Differentiate between hard and soft skills, Discipline specific skills Vs soft skills, Employability skills and its types, Learning & core values. The confidence grid, The power of thoughts, How Thoughts work, Anxiety, Decoding Self confidence , Self confidence cycle, Techniques, Protecting self Confidence, Building positive self Image, Affirmations.

2. Time Management: Time, Time Management, Need for time management, Benefits of time management, Obstacle of Time management, What can we do, How to use Time effectively, Set goals, Prioritize Work, Organizing the work, When to say No, Identifying, celebrating success.

3. Presentation Skills: Important Tips, Role of Power point presentation.

4. Leadership Skills: Leadership, Identifying the traits and skills of an effective leader, examine the role, understanding the limits of authority in a team leader's role.

5. Team Work: Objectives, What are Goals, Categorization of Goals, 5 Philosophies for goals, Types of goals?

6. Conversational Skills: Dialogues, Short Stories.

MODULE 2 : ENGLISH LANGUAGE ACQUISITION PROGRAM(ELAP)

1. Grammar in Action: Subject-Verb Agreement, Idioms& Phrases, Common spoken Language errors, Direct-Indirect speech, Phrasal Verbs, Active Passive Voice.

2.Written Communication & Formal Correspondence: Notice Writing, Circular Writing, Technical Report Writing, Project Writing, e-mail etiquettes

3. Comprehension: Listening & Reading comprehension.

- ❖ All the contents of above modules shall be covered during the course of the practical sessions.
- ❖ Activities on the above modules must be conducted wherever applicable.

Text Books Recommended
1. The ACE of Soft Skills-Attitude, Communication and Etiquette for Success - Gopalaswamy Ramesh and Mahadevan Ramesh, 1st Edition, 2010, Pearson Publication.
2. Corporate Softskills - Sarvesh Gulati, 5th Edition, 2012, Rupa & Co. Publication.

Reference Books Recommended
Soft skills - Know yourself and know the world - Dr. K. Alex, 2009, S. Chand Publication.

Dr. S. Anwar

Dr. V. Asudani

COURSE SYLLABUS

FOR

SEMESTER–V

B. TECH.
ARTIFICIAL INTELLIGENCE
(AI) & DATA SCIENCE

(W. E. F. 2023-24)

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
PCCAD501T	Theory of Computation	3	-	-	3	40	60	100	3

Course Objective
The learners will be able to understand the basic concepts of formal languages and various models of computation. Also, they will be able to design mathematical machines for real time problems which enhance logical thinking and improve employability.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Illustrate the basic concepts of formal languages and various models of computation.
CO2	**Analyze:** Analyze the given automata or machines and find out its language.
CO3	**Understand:** Demonstrate formal relationships among machines, languages and grammars.
CO4	**Analyze:** Analyze the decidability of a problem using a Turing machine.
CO5	**Create:** Design automata, regular expression, Pushdown automata and Turing Machine for a given language.

SYLLABUS

UNIT I: Fundamentals of Languages and Finite Automata

Alphabet, Symbols, Sets, Strings, Language, Operations, Relations, Chomsky hierarchy of languages, Design of Finite State Machines, Acceptance of strings and languages, Non-Deterministic Finite Automaton, Deterministic Finite Automaton, Equivalence between NFA and DFA, NFA with ε-transition, Minimization of FA, FSM with output.

UNIT II: Regular Language and Grammar

Regular sets, Regular expressions, Manipulation of regular expressions, Equivalence between RE and FA, Pumping Lemma for regular set, Closure properties of regular sets (Proofs not required), Regular grammars, Right linear and left linear regular grammars, inter-conversion between LLG & RLG, Equivalence between regular grammar and FA, Inter-conversion between RE and RG.

UNIT III: Context Free Grammar
Context free grammar, Derivation trees (Syntax tree and Parse tree), Ambiguous Grammar, Simplification of CFG, Context Free Language (CFL), Pumping Lemma for CFL, Closure properties of CFL, Normal Form of CFG: Chomsky Normal form, Greibach Normal form.
UNIT IV: Push Down Automata
Definition and model of Push Down Automata (PDA), acceptance of CFL by empty Stack and by final state, Design of PDA (DPDA & NPDA) equivalence of CFL & PDA, Inter-conversion of PDA & CFG.
UNIT V: Turing Machine
Definition, Model of TM, Designing of Turing Machine as an accepter and as a transducer, types of Turing machines, Church's hypothesis, Linear bounded automata and context sensitive language.
UNIT VI: Undecidability
Decidability of problems, Recursive enumerable language, Recursive Language, Properties of Recursive enumerable language, Halting problem of Turing machine, Universal Turing Machine, Undecidability, primitive recursive functions, Posts Correspondence problem, Ackerman's function.

Text Books
1. Introduction to Automata Theory Languages and Computation, Hopcroft H. E., Ullman J. D., 3rd Edition, 2008, Pearson Education.
2. Introduction to languages and the Theory of Computation, John C. Martin, 3rd Edition, 2002, Mc-Graw Hill.

Reference Books
1. Introduction to Theory of Computation, Michael Sipser, 3rd Edition, 2006, Cengage Learning.
2. Theory of Computer Science: Automata, Languages and Computation, K. L. P. Mishra, Chandrashekharan, 3rd Edition, 2008, Pearson Education.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD502T	Design & Analysis of Algorithms	3	-	-	3	40	60	100	3

Course Objective
The course imparts knowledge of design and analysis of algorithms to improve problem solving capabilities and analytical skills to enhance employability.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Explain the role of mathematical foundations in NP problem, decision and optimization problems, non-deterministic, graph-based and approximation algorithms.
CO2	**Analyze:** Examine worst-case running times of searching and sorting algorithms using asymptotic analysis and amortized analysis.
CO3	**Apply:** Make use of various methodologies to solve recurrence relations.
CO4	**Apply:** Demonstrate various strategies like, divide and conquer, greedy, dynamic programming and backtracking for problem solving and basic traversal techniques for searching problems.
CO5	**Evaluate:** Select suitable Data structure and algorithm to address the given situation.

SYLLABUS

UNIT I: Recurrences and Asymptotic Notations

Introduction: Algorithm definition, algorithm characteristics, principles of designing algorithms.
Performance Analysis: Space complexity, time complexity, asymptotic notations- big-oh notation, omega notation, theta notation.
Recurrence Relations: Solutions of recurrence relations using techniques of characteristic equation, generating functions, master method and substitution method.

UNIT II: Divide and Conquer

Basic strategy, matrix operations, Strassen's matrix multiplication, binary search, quick sort, merge sort, amortized analysis, application of amortized analysis, advanced data structures like Fibonacci heap, binomial heap, disjoint set representation

UNIT III: Greedy Method

Basic strategy, fractional knapsack problem, application to job sequencing with deadlines problem,

minimum cost spanning trees, single source shortest path – Prim's algorithm, Kruskal's algorithm and Dijkstra's algorithm, optimal search patterns, activity selection problem.
UNIT IV: Dynamic Programming Basic strategy, multistage graphs, all pairs shortest path-Floyd Warshall algorithm, single source shortest paths-Bellman Ford algorithm, optimal binary search trees, traveling salesman problem, longest common subsequence problem, chained matrix multiplication.
UNIT V: Basic Traversal and Search Techniques Search Techniques: Breadth first search and depth first search, connected components. Backtracking: Basic strategy, 8-Queen's problem, graph coloring, Hamiltonian cycles. Branch and Bound: 0/1 knapsack problem Approximation Algorithm: Introduction, vertex cover problem, subset sum problem.
UNIT VI: NP-Completeness Basic concepts, non-deterministic algorithms, NP, P, NP-hard and NP-complete, decision and optimization problems, graph-based problems on NP Principle.

Text Books
1. Computer Algorithms, Horowitz, Sahani, Rajasekaram, 2008, Silicon Press.
2. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, 3rd Edition, 2009, PHI Learning.

Reference Books
1. Fundamentals of Algorithms, Brassard, Bratley, 1st Edition, 1995, Prentice Hall.
2. Design and Analysis of Algorithms, Aho, Ullman, Hopcroft, 1st Edition, 2002, Pearson Education.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD502P	Design & Analysis of Algorithms Lab	-	-	2	1	25	25	50	-

Course Objectives
To choose the appropriate data structure and algorithm design strategy for a specific application and solve the problems in an intelligent and effective way to improve employability.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Apply:** Demonstrate the knowledge of basic data structures and use them for implementing the solution in a best suited way.
CO2	**Evaluate:** Determine the computational complexity of an algorithm to perform particular task.
CO3	**Evaluate:** Evaluate the performance of different algorithms when applied to a given problem.
CO4	**Create**: Design code using various algorithms for solving problems.

A minimum of eight practical to be performed based on the theory course Design & Analysis of Algorithms [PCCAD502T].

Suggested References
1. Computer Algorithms, Horowitz, Sahani, Rajasekaram, 2008, Silicon Press.
2. Fundamentals of Algorithms, Brassard, Bratley, 1st Edition, 1995, Prentice Hall.
3. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, 3rd Edition, 2009, PHI.
4. Design and Analysis of Algorithms, Aho, Ullman, Hopcroft, 1st Edition, 2002, Pearson Education.

Course Code	Course Title	Hours/Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD503T	Software Engineering & Project Management	2	-	-	2	20	30	50	2

Course Objective
The course enables students to understand both theoretical and methodological issues involved in modern software engineering and project management of software systems to improve their employability and technical skills.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Explain the basic concepts of Software Engineering & relate appropriate software models and technologies to bring out innovative and novelistic solutions for the software development.
CO2	**Create:** Analyze and design the software architectures with the help of different UML diagrams.
CO3	**Evaluate:** Determine an appropriate project management approach through an evaluation in accordance with business context and scope of the project.
CO4	**Create:** Design various estimation levels of cost and effort required for Project Management.

SYLLABUS
UNIT I: Software Process Introduction: Evolution of Software Engineering, Layered Technology Approach, Characteristics of Software, Software Process Framework. Perspective Process Models: Waterfall model, Incremental Model, RAD Model, Evolutionary Process model (Prototyping & Spiral Model), Agile Model for Software Development.
UNIT II: System Analysis System Analysis: Requirement Engineering, Data modeling, Object-Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, Class-based Modeling, Behavioral Model. Design Concepts: Abstraction, Pattern modularity, Information hiding, Design classes, Refactoring.
UNIT III: Project Management Project Management: Introduction to Software Project Management, Project Planning, Project scheduling, Risk management, Change Management, Software reengineering, Restructuring Reverse engineering, Forward Engineering.
UNIT IV: Quality Management Quality Concepts: Software Quality, Software Reviews, Formal Technical Review, Software Reliability. Quality Assurance Activities: SQA, Software Configuration Management, SCM Repository, SCM Process, Estimation.

Quality Standards: ISO 9000 and Companion ISO Standards, CMMI, Six Sigma.

Text Books:
1. Software Engineering-A Practitioner's Approach, Roger Pressman, 7th Edition, 2010, McGraw Hill.
2. Software Engineering, Ian Sommerville, 9th Edition, 2011, Pearson Education Asia.

Reference Books:
1. Fundamentals of Software Engineering, Rajib Mall, 3rd Edition, 2009, PHI Learning Private Limited.
2. Software Quality Assurance: From Theory of Implementation, Daniel Galin, 2nd Edition, 2012, Pearson Addison-Wesley.
3. Software Engineering, David Gustafsan, Schaum's Series, 2002, Tata McGraw Hill.
4. Software Project Management - Sanjay Mohapatra, 1st Edition, 2011, Cengage Learning.

Course Code	Course Title	Hours /Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD503P	Software Engineering & Project Management Lab	-	-	4	2	25	25	50	-

Course Objective
The lab course enables students to understand the software engineering methodologies involved in the phases for project development to enhance their employability and technical skills.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Explain the software engineering methodologies involved in the phases for project development.
CO2	**Apply:** Apply appropriate software models and technologies to bring out innovative and novelistic solutions for the software development.
CO3	**Analyze:** Analyze open-source tools used for implementing software engineering methods.
CO4	**Create:** Develop product-prototypes implementing software engineering methods.

A minimum of eight practical to be performed based on the theory course Software Engineering & Project Management [PCCAD503T].

Suggested References:
1. Software Engineering-A Practitioner's Approach, Roger Pressman, 7th Edition, 2010, McGraw Hill.
2. Software Engineering, Ian Sommerville, 9th Edition, 2011, Pearson Education Asia.
3. Software Quality Assurance: From Theory of Implementation, Daniel Galin, 2nd Edition, 2012, Pearson Addison-Wesley.
4. Software Quality Engineering: Testing, Quality Assurance and Quantifiable, Jeff Tian, 2005, Wiley.

Course Code	Course Title	Hours /Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD504T	Data Analytics	2	-	-	2	20	30	50	2

Course Objective
The course will enable the students to understand the fundamental of data analytics, storage, retrieval and processing of data and perform variety of analytics on different datasets using suitable tools to improve employability and technical skills.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Explain the concept of big data and life cycle of data analytics used in the real-world applications.
CO2	**Analyze:** Analyze various methods and models for data analysis.
CO3	**Apply**: Apply different Techniques for classification and data visualization and compare the techniques for their applicability.
CO4	**Apply**: Make use of various libraries of Python, PowerBI, Tableau and other tools to efficiently store and process data to generate useful analysis.

SYLLABUS
UNIT I: Introduction to Data Analytics and Life Cycle Introduction: Big data overview, state of the practice in Analytics- BI Vs Data Science, Current Analytical Architecture, Drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Overview, Phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Operationalize.
UNIT II: Data Analytics Methods Statistical Methods for Evaluation- Hypothesis testing, difference of means, Wilcoxon rank–sum test, type 1 type 2 errors, power and sample size, ANOVA. Clustering: Overview, K means, validation and testing, diagnostics. Regression: Linear, logistics, reasons to choose and cautions, additional regression models.

Unit III: Classification and Data Visualization Techniques

Decision trees algorithm, evaluating a decision tree, Introduction to Data visualization, Challenges to data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Analytical techniques used in data visualization.

Unit IV: Advanced Data Analytics using Python

Machine learning tools, machine learning algorithms using Scikit-Learn, data visualizations using Matplotlib, Data Framing using Pandas, NumPy, IPython based computational platforms, Dashboard design using Power-BI and Tableau, Issues and assessment of needs, Considerations for designing dashboard - visual perception.

Text Books:

1. Data Analytics using Python, Bharti Motwani, 2020, Wiley Publication.
2. Python Data Analysis: Perform data collection, data processing, wrangling, visualization, and model building using Python, Avinash Navlani, Armando Fandango, Ivan Idris, 3rd Edition, 2021, Packt Publishing Limited.

Reference Books:

1. Big Data Analytics, Seema Acharya, Subhashini Chellappan, 1st Edition, 2015, Wiley.
2. Big Data Analytics with R and Hadoop, Vignesh Prajapati, 1st Edition, 2013, Packet Publishing Limited.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD504P	Data Analytics Lab	-	-	2	1	25	25	50	-

Course Objective
The course lab will enable the students to apply the different frameworks for data analytics, storage, retrieval and processing and perform variety of analytics on different datasets using suitable tools to improve employability and technical skills.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Apply:** Apply the concept of big data and life cycle of data analytics used in the real-world applications.
CO2	**Analyze:** Analyze various methods and models for data analysis.
CO3	**Analyze:** Examine different techniques for classification and data visualization and compare the techniques for their applicability.
CO4	**Create:** Design applications using various libraries of Python, PowerBI, Tableau and other tools to efficiently store and process data to generate useful analysis.

A minimum of eight practical to be performed based on the theory course Data Analytics [PCCAD504T].

Suggested Reference:
1. Data Analytics using Python, Bharti Motwani, 2020, Wiley Publication.
2. Python Data Analysis: Perform data collection, data processing, wrangling, visualization, and model building using Python, Avinash Navlani, Armando Fandango, Ivan Idris, 3rd Edition, 2021, Packt Publishing Limited.
3. Big Data Analytics, Seema Acharya, Subhashini Chellappan, 1st Edition, 2015, Wiley.
4. Big Data Analytics with R and Hadoop, Vignesh Prajapati, 1st Edition, 2013, Packet Publishing Limited.

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem. Exam	Total	Duration (Hrs.)
OECAD501T	**Web Development using Python**	3	0	0	3	40	60	100	3

Course Objective
The course provides students a comprehensive overview of web page development using various frameworks supported by python programming that enhances their employability and technical skills.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	**Understand:** Explain the process of web development using various web frameworks.
CO2	**Apply:** Apply the concepts of Django and Flask web framework in development of web applications.
CO3	**Apply:** Build a web application using different templates, media files, models and databases.
CO4	**Analyze:** Analyze the process of web development using Django and Flask.
CO5	**Design:** Design a web application and deploy it to solve a real-world problem.

SYLLABUS
UNIT I: Introduction of Django Introduction of Django: Need of framework, Feature of Django Framework, MVT (Model-View-Template) architecture, Django Installation, Project Set-Up: Project structure, Creating Django Project, Creating applications, Creating view, Mapping URL, Managing workflow
UNIT II: Templates and Media Files Using Templates, Configuring the Templates Directory, Adding a Template, Static Media Files, Configuring the Static Media Directory, Static Media Files and Templates, Serving Media files.
UNIT III: Models and Databases Creating Models, Creating and Migrating the Database, Models and the Shell, Configuring the Admin Interface, Creating a Population Script, Models, Templates and Views
UNIT IV: Forms, Templates and User Authentication Forms and Templates: Page and Category Forms, Relative URLs in Templates, Dealing with Repetition, Template Inheritance, render Method and request Context, Custom Template Tags, User Authentication: Setting up Authentication, Password Hashing and Validators, User Model, User Attributes, Creating a User Registration, Login Functionality.

UNIT V: Query, Testing and Deploying Your Project Including JQuery in Django Project/App, AJAX based Functionality, Automated Testing, Deploying Your Project: Creating a PythonAnywhere Account and Web Interface, Virtual Environment, Setting up Your Web Application.
UNIT VI: Web Apps with Flask Installing Flask, Creating a Simple Application, Running the Application, Routes and View Functions, Dynamic Routes, Debugging A Flask Application.

Text Books:
1. How to Tango with Django 1.9, A Beginners Guide to Python/Django, Leif Azzopardi, David Maxwell, 1st Edition, 2017, Lean Publishing.
2. Flask Web Development 2e: Developing Web Applications with Python, 2018, O'Reilly Publication.

Reference Books:
1. Web Development with Django: Learn to Build Modern Web Applications with Python, 2021, Packt Publication.
2. Learn Web Development with Python: Get hands-on with Python and Django, 2018, Packt Publication.

22/02/2023
Dr. M S Nimbarte

Dr. Richa Mahajani

Dr. S. S. Badhiye

Dr. A. Tayal

22/02/2023
S. A. Ladke

Dr. R. Jain
22/2/23

Md. Ashar

R. B. Talmale
22/2/23

COURSE SYLLABUS

FOR

SEMESTER – VI

B. TECH.

ARTIFICIAL INTILLIGENCE(AI) AND DATA SCIENCE

(W.E.F. 2023-24)

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD601T	Compiler Design	4	-	-	4	40	60	100	3

Course Objective

The learners will be able to explore the principles, algorithms, and data structures involved in the design of compilers. Also, they will be able to understand various phases of compilation and their working, which enhance logical thinking and improve employability.

Course Outcomes

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

CO1	**Understand:** Demonstrate the various phases of compilation, with understanding of lexical analysis in compiler design.
CO2	**Create:** Design Parsers using top-down and bottom-up parsing techniques for given grammar in syntax analysis.
CO3	**Apply:** Make use of syntax directed translation schemes and construct Intermediate code for a given set of productions
CO4	**Apply:** Make use of different code optimization and generation techniques on various intermediate codes to generate efficient target code.
CO5	**Apply:** Choose a data structure for symbol table organization to store various attributes and apply different error recovery tools on parsers.

SYLLABUS

UNIT I: Introduction to Compilers

Introduction, Definition, phases & passes of compiler design, compiler writing tools, relation of compilation phases with formal languages.

Lexical Analysis: Introduction, tokens, pattern and lexemes, design of lexical analyser, role of regular expression and finite automata in recognition of tokens, lexical errors.

UNIT II: Syntax Analysis

Introduction, Context free grammars (CFG), Ambiguous Grammars, Simplification of CFG, Top- down parser, design of predictive- LL(1) parser, bottom-up parsing technique, Handle and Viable Prefix, LR parsing, Design of SLR, CLR, LALR parsers, Parser Conflicts, Implementation of Parsers.

UNIT III: Intermediate Code Generation

Syntax Directed Translation: Syntax directed definition, S-attributed and L-attributed definitions, translation schemes.

Intermediate Code Generation: Intermediate forms of source programs - abstract syntax tree, polish notation and three address code, types of three address statements and its implementation, syntax directed

translation into three-address code, translation of simple statements, Boolean expressions and flow-of-control statements, declarations and array reference.
UNIT IV: Storage Allocation & Error Handling Symbol Table Management: Storage allocation and run time storage administration, symbol table management. Error Detection and Recovery: Error recovery in LR parsing, Error recovery in LL parsing, automatic error recovery in YACC.
UNIT V: Code Optimization Basic blocks and flow graphs, Local and global optimization techniques, loop optimization- control flow analysis, data flow analysis, Loop invariant computation, Induction variable removal, other loop optimization techniques, Elimination of Common sub expression, directed acyclic graph (DAG) and its applications
UNIT VI: Code Generation Problems in code generation, simple code generator, code generation using labelling algorithm and DAG, Heuristic DAG ordering, register allocation and assignment, Peephole optimization.

Text Books:
1. Compilers, Principles, Techniques and Tools, Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, 2nd Edition, 2007, Pearson education.
2. Principles of Compiler Design, Alfred V. Aho, Jeffery D. Ullman, 1998, Narosa Publishing House.

Reference Books:
1. Compiler Design Using FLEX and YACC, Vinu V. Das, 2007, PHI Learning Publication.
2. Compiler Design, Dr. O. G. Kakde, 2008, Laxmi Publications.
3. Principles of Compiler Design, V. Raghavan, 2010, McGraw Hill Education (India).

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD602T	Basics of Machine & Deep Learning	3	-	-	3	40	60	100	3

Course Objective
The course will enable the students to formulate machine learning problems corresponding to an application by applying various types of learning and optimization techniques to improve employability and technical skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Interpret the basic concepts of supervised, unsupervised and reinforcement learning strategies for machine learning.
CO2	**Analyse:** Categorize the machine learning and deep Learning models and algorithms and apply them by analysing the nature of given problem.
CO3	**Analyse:** Analyse the concept of neural networks such as CNN, RNN and its types for learning various activation functions and their applications.
CO4	**Apply:** Apply the concepts in Bayesian analysis from probability models and methods to solve classification problems.
CO5	**Apply:** Apply different models and algorithms of machine learning and deep Learning for an application.

SYLLABUS [Make it light]
UNIT I: Basics of Machine Learning Introduction to Machine Learning, supervised learning, unsupervised learning, reinforcement learning, cost and loss function. Regression, k-Nearest neighbour algorithm, decision tree learning, random forest, Rule based learning.
UNIT II: Artificial Neural Networks & Classifiers Artificial neural networks: types of learning, activation and loss functions, introduction of multilayer networks and back-propagation. Probabilistic machine learning maximum likelihood estimation, MAP, Bayes classifiers Naive Bayes, Bayes optimal classifiers.
UNIT III: Bayesian Networks & Clustering Bayesian Networks, inference in Bayesian Networks, Bayes Net Structure, learning unlabelled data: Expectation-Maximization. Introduction to clustering, hierarchical clustering, K-means clustering.

UNIT IV: Basics of Deep Learning
Limitations of Machine Learning, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis, Singular Value Decomposition.

UNIT V: Auto Encoders & Regularization
Auto encoders and relation to PCA, Regularization in auto encoders, De-noising auto encoders, Sparse auto encoders, Contractive auto encoders, Bias Variance Trade-off, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout

UNIT VI: Convolutional & Recurrent Neural Networks
The Convolution Operation, Motivation, Pooling, LeNet, AlexNet, Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients.

Text Books:

1. Machine Learning, Amit Kumar Das, Saikat Dutt, Subramanian Chandramouli, 1st Edition, 2018, Pearson Education India.
2. Neural Networks and Deep Learning, Charu C. Aggarwal, 2018, Springer International Publishing.
3. Deep Learning from Scratch, Building with Python from First Principles, Seth Weidman, 1st Edition, 2019, O'Reilly Media.

Reference Books:

1. Machine Learning –An Algorithmic Perspective, Stephen Marsland, 2nd Edition, 2011, CRC Press.
2. Hands-On Deep Learning Algorithms with Python, Sudharsan Ravichandiran, 2019, Packt Publishing Limited.
3. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 1st Edition, 2016, The MIT Press

Course Code	Course Title	Hour/Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PCCAD602P	Basics of Machine & Deep Learning Lab	-	-	2	1	25	25	50	-

Course Objective
The lab course will enable the students to formulate real world machine and deep learning problems by applying various types of learning and optimization techniques that improves technical skills of learners.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Make use of different algorithms for supervised, unsupervised and reinforcement learning.
CO2	**Apply:** Apply structured thinking to unstructured problems in the domain of machine learning.
CO3	**Apply:** Apply various deep learning algorithms and techniques on real datasets.
CO4	**Apply:** Apply different models and algorithms of machine learning and deep Learning for an application.

A minimum of eight practical to be performed based on the theory course of Basics of Machine & Deep Learning [PCCAD602T]

Suggested References:
1. Machine Learning –An Algorithmic Perspective, Stephen Marsland, 2nd Edition, 2011, CRC Press.
2. Hands-On Deep Learning Algorithms with Python, Sudharsan Ravichandiran, 2019, Packt Publishing Limited
3. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 1st Edition, 2016, The MIT Press

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD601T	Digital Image Processing	3	-	-	3	40	60	100	3

Course Objective

The course will enable the students to understand the concepts of image fundamentals and mathematical transform necessary for image enhancement process to improve employability and technical skills.

Course Outcomes

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

CO1	**Understand:** Interpret the fundamental concept of digital image processing system and perform mathematical transformation on digital images.
CO2	**Analyse:** Analyse images in frequency domains using various transform.
CO3	**Analyse:** Categorize the various compression techniques and inspect image compression standard.
CO4	**Evaluate:** Evaluate the techniques for image enhancement and image restoration.
CO5	**Create:** Develop image processing application using suitable image enhancement technique.

SYLLABUS

UNIT I: Introduction to Digital Image Processing
Fundamentals of Elements of Digital Image, Image as Data, Pixels, Components of Digital Image, Types of Image Representation, Measures of Image, Neighbours of pixel adjacency connectivity, Regions and boundaries, Distance measures, Application of Digital Image Processing.

UNIT II: MATLAB Basics
Introduction to Data Types, Operators, Matrices, File, I/O, Image Processing Toolbox.

UNIT III: Image Enhancement Techniques
Spatial Domain: Basic Gray level transformations, Histogram processing, using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters.
Frequency domain: Introduction to the Fourier transform and frequency domain concepts, smoothing frequency-domain filters, Sharpening frequency domain filters.

UNIT IV: Image Filtering Techniques
Low Pass Filters: Smoothing, High Pass Filters - Edge Detection, Sharpening, Image Restoration Noise Models, Model of Image Degradation/Restoration Process, Noise Reduction, Inverse Filtering, M Minimum Mean Square Error (Weiner) Filtering.

UNIT V: Image Processing

Colour Image processing: Colour fundamentals, Colour models, Representation of Colour in Images, Colour transformation, Smoothing and Sharpening, Colour segmentation.
Image Morphology: Different Morphological Algorithm, Morphological Measures.

UNIT VI: Compression and Segmentation

Image Compression: Introduction, Image compression model, Types of redundancies, Error-free compression, Lossy compression.
Image Segmentation: Thresholding, Histogram Based Segmentation, Clustering, Region Growing Method, Point, Line and Edge Detection; Applications of digital image processing in different domains.

Text Books:

1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, 2008, Pearson Education.
2. Fundamentals of Digital Image Processing, Anil K. Jain, 2nd Edition, 2002, PHI Publication.
3. Digital Image Processing Using MATLAB, Gonzalez & Woods, 3rd Edition, 2020, Gatesmark Publishing.

Reference Books:

1. Digital Image Processing, Kenneth R. Castleman,1st Edition, 2007, Pearson Education India.
2. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 2nd Edition, 2011, McGraw Hill Education.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD601P	Digital Image Processing Lab	-	-	2	1	25	25	50	-

Course Objective
The lab course will enable the students to design the applications for image processing that improves their technical skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Analyse:** Analyse images in frequency domains using various transform.
CO2	**Analyse:** Categorize the various compression techniques and inspect image compression standard.
CO3	**Evaluate:** Evaluate the techniques for image enhancement and image restoration.
CO4	**Create:** Develop image processing application using suitable image enhancement technique.

A minimum of eight practical to be performed based on the theory course of Digital Image Processing [PECAD601T]

Suggested References:
1. Digital Image Processing, Kenneth R. Castleman, 1st Edition, 2007, Pearson Education India.
2. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 2nd Edition, 2011, McGraw-Hill Education.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD602T	Cyber Security	3	-	-	3	40	60	100	3

Course Objective
The course provides students with a comprehensive overview of the threats to computer security, technologies for security assurance, and engineering approaches to security solutions that enhances employability and develop technical skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Illustrate the concept of cyber security, cybercrime, cyber law and challenges associated with it.
CO2	**Apply:** Identify various network defence tools for security of networks and apply security policies.
CO3	**Analyze:** List various methods for digital payments, related common frauds and preventive measures needed in E- Commerce.
CO4	**Analyze:** Analyze the various privacy and security concerns of social media platforms.
CO5	**Evaluate:** Determine the security of end point device, mobile phone and role of firewall and anti-virus for security of sensitive online information.

SYLLABUS

UNIT I: Introduction to Cyber Security

Overview of Cyberspace, Architecture of Cyberspace, Communication and Web Technology, Internet Infrastructure for Data Transfer and Governance, Internet society, Regulation of Cyberspace, Concept of Cyber Security, Issues and Challenges of Cyber Security.

UNIT II: Cyber Crime and Cyber Law

Classification of Cybercrimes, Cybercrime Targeting Computers and Mobiles, Cybercrime Against Women and Children, Financial Frauds, Social Engineering Attacks, Malware and Ransomware Attacks, Zero Day and Zero Click Attacks, Cybercriminals Modus-Operandi, Reporting of Cybercrimes, Remedial and Mitigation Measures, Legal Perspective of Cybercrime, IT Act 2000 and its Amendments, Cybercrime Offences.

UNIT III: Network Defence Tools
Firewalls and Packet Filters: Firewall Basics, Packet Filter vs Firewall, Firewall Protection, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, Virtual Private Networks.
Firewall: Introduction, Linux Firewall, Windows Firewall.

UNIT IV: Social Media Overview and Security
Introduction to Social Networks, Types of Social Media, Social Media Platforms, Social media monitoring, Hashtag, Viral Content, Social Media Marketing, Social Media Privacy, Challenges, Opportunities and Pitfalls in online social network, Security Issues Related to Social Media, Flagging and Reporting of Inappropriate Content, Laws Regarding Posting of Inappropriate Content, Best Practices for the use of Social Media, Case Studies.

UNIT V: E-Commerce and Digital Payments
E-Commerce: Definition, Main components, Elements, Security, threats, Security Best Practices, Digital Payments: Introduction, Components and Stake Holders, Modes of Digital Payments, Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar Enabled Payments, Common Frauds and Preventive Measures, RBI Guidelines, Customer Protection in Unauthorized Banking Transactions.

UNIT VI: Digital Devices Security, Tools and Technologies
End Point Device and Mobile Phone Security, Password Policy, Security Patch Management, Data Backup, Downloading and Management of Third-Party Software, Device Security Policy, Significance and Management of Host Firewall and Anti-Virus, Wi-Fi Security, Public Key Infrastructure.

Text Books:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Sumit Belapure, Nina Godbole, 2011, Wiley India Pvt. Ltd.
2. Introduction to Cyber Security, Anand Shinde, 2021, Notion Press.

Reference Books:

1. Cyber Security and Cyberwar: What Everyone Needs to Know, Peter W. Singer, Allan Friedman, 2014, Oxford University Press India
2. Hands-on Ethical Hacking and Network Defense, James Corley, Kent Backman, Michael Simpson, 2nd Edition, 2010, Delmar Cengage Learning.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD602P	Cyber Security Lab	-	-	2	1	25	25	50	-

Course Objective
The course develops an ability to use various open-source security tools to improve information and network security that enhance employability and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Demonstrate different network security and computer security, various attacks on network.
CO2	**Create:** Construct various conventional cryptography algorithms and asymmetric encryption algorithms, Message authentication, Hash function and public key encryption.
CO3	**Apply:** Develop security requirements for web application.

A minimum of eight practical to be performed based on the theory course of Cyber Security [PECAD602T]

Suggested References:
1. Hands-on Ethical Hacking and Network Defense, James Corley, Kent Backman, Michael Simpson, 2nd Edition, 2010, Delmar Cengage Learning.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Sumit Belapure, Nina Godbole, 2011, Wiley India Pvt. Ltd.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD603T	GPU Computing	3	-	-	3	40	60	100	3

Course Objective [Take it from CSE]
The course provides the students an insight to popular CUDA programming model commonly used for implementing various aspects of parallel architecture and GPU programming that enhances employability.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Interpret the basic concepts of parallel computing, GPGPU, GPU computing for parallel programming.
CO2	**Apply:** Identify the need of parallel architecture and know the evolution of modern GPU architecture.
CO3	**Apply:** Make use of skills and modern engineering tools like CUDA programming and execution model to address data parallelism.
CO4	**Analyze:** Examine the importance of memory, performance, floating point considerations and optimization in GPU computing.
CO5	**Evaluate:** Evaluate the performance of various applications in well-known GPU computing scenarios.

SYLLABUS
UNIT I: Introduction Parallel Computing Review of Traditional Computer Architecture, Heterogeneous Parallel Computing, Architecture of a Modern GPU, Need of More Speed or Parallelism, Speeding Up Real Applications, Parallel Programming Languages and Models.
UNIT II: Evolution of GPU Architectures Evolution of Graphics Pipelines, Fixed-Function Graphics Pipelines, Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU, GPU Computing, Scalable GPUs, Recent Developments.
UNIT III: Data Parallelism and CUDA Data Parallelism, CUDA Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading, Function Declarations, Kernel Launch, Predefined Variables, Runtime APIs.

UNIT IV: Execution Model
CUDA Thread Organization, Mapping Threads to Multidimensional Data, Matrix-Matrix Multiplication, Synchronization and Transparent Scalability, Assigning Resources to Blocks, Querying Device Properties, Thread Scheduling and Latency Tolerance.

UNIT V: Memories and Performance Considerations
Memories: Importance of Memory Access Efficiency, Device Memory Types, Reducing Global Memory Traffic, Memory as a Limiting Factor to Parallelism.
Performance Considerations: Warps and Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of Execution Resources, Instruction Mix and Thread Granularity.

UNIT VI: Floating-Point Considerations and Applications
Floating-Point Considerations: Floating-Point Format, Representable Numbers, Special Bit Patterns and Precision in IEEE Format, Arithmetic Accuracy and Rounding, Algorithm Considerations.
Applications: Applications of GPU Architecture like Gaming, Computer Vision, and Optimizing GPU Applications.

Text Books:

1. Programming Massively Parallel Processors: A Hands-on Approach, David B. Kirk and Wen-mei W. Hwu, 2nd Edition, 2013, Elsevier Inc.
2. Multicore and GPU Programming an Integrated Approach, Gerassimos Barlas, 1st Edition, 2015, Elsevier Inc.

Reference Books:

1. Heterogeneous Computing with OpenCL, Benedict Gaster, Lee Howes, David R. Kaeli
2. Computer Architecture: A Quantitative Approach, John L. Hennessy, David A. Patterson

Course Code	Course Title	Hour/Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD603P	GPU Computing Lab	-	-	2	1	25	25	50	-

Course Objective
The course provides the students a hands-on approach to popular CUDA programming model commonly used for implementing various aspects of parallel architecture and GPU programming that enhances employability and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Utilize the basic concepts of parallel computing, GPGPU, GPU computing for parallel programming.
CO2	**Apply:** Make use of skills and modern engineering tools like CUDA programming and execution model for offloading work onto GPUs as accelerators for various applications.
CO3	**Analyze:** Examine the importance of memory, performance, floating point considerations and optimization in GPU computing.
CO4	**Evaluate:** Evaluate the performance of various applications in well-known GPU computing scenarios.

A minimum of eight practical to be performed based on the theory course of course GPU Computing [PECAD603T]

Suggested References:
1. Programming Massively Parallel Processors: A Hands-on Approach, David B. Kirk and Wen-mei W. Hwu, 2nd Edition, 2013, Elsevier Inc.
2. Multicore and GPU Programming an Integrated Approach, Gerassimos Barlas, 1st Edition, 2015, Elsevier Inc.
3. Heterogeneous Computing with OpenCL, Benedict Gaster, Lee Howes, David R. Kaeli, 2012, Elsevier Science
4. Computer Architecture: A Quantitative Approach, John L. Hennessy, David A. Patterson, 2017, Elsevier Science

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD604T	NLP for Indian Languages	3	-	-	3	40	60	100	3

Course Objective

The course introduces the learners with essentials of natural language processing of Indian languages like, linguistic aspects, core algorithms for solving basic tasks and statistical and machine learning models for different Indian language processing tasks.

Course Outcomes

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

CO1	**Understand:** Illustrate the key features of NLP in Indian languages.
CO2	**Apply:** Identify the basics of automata theory and parsing techniques for natural languages.
CO3	**Analyse:** Analyse the Indian language structures and NLP models for Indian languages.
CO4	**Apply:** Model systems for language processing, Semantic, Syntactic analysis and related tasks involved in text processing.
CO5	**Analyze:** Examine sentiment analysis, text entailment, machine translation and other Indian language processing applications using different Python libraries.

SYLLABUS

UNIT I: Introduction to Indian languages
Introduction to Indian languages, language structure of Indian languages, challenges, limitations, and opportunities of Indian languages, applications of NLP in Indian languages, Natural Language Processing concept, Ambiguity and uncertainty in language, Turing test, Role of Machine Learning in NLP.

UNIT II: Computation Theory
Chomsky hierarchy, regular languages, and their limitations. Finite-state automata, Practical regular expressions for finding and counting Indian language phenomena, Indian language morphology, exploring corpus with regex tools.

UNIT III: Basics of Lexical and Semantic Analysis
Lexical Knowledge Networks, Basic ideas in Lexical Semantics, WordNet and WordNet based similarity measures, Distributional measures of similarity, WordNet Application in Query Expansion Concept Mining using Latent Semantic Analysis, Multilingual Dictionaries, Semantic Roles, Word Sense Disambiguation, WSD and Multilinguality.

UNIT IV: Parsing and Speech Recognition
Noun Structure Top-Down Parsing Algorithms, Non-noun Structure Top-Down Parsing Algorithms Probabilistic Parsing: Sequence labelling, PCFG, Training issues, Arguments and Adjuncts, inside-outside probabilities.

UNIT V: Language Models
Language models, Hidden Markov Models (HMM), Morphology, Graphical Models for Sequence Labelling in NLP, Models of anaphora resolution, Machine learning methods for reference, Text Entailment, POS Tagging, Phonology, ASR, Speech Synthesis, HMM and Viterbi, topic modelling.

UNIT VI: Natural language Processing for Indian regional languages and Application
Supporting libraries for Indian languages (iNLTK, Indic NLP, Stanford NLP), Text Processing for Indian Languages.
Applications: Multilingual Chatbots, Language Translator, Sentiment Analysis, Cross Lingual Information Retrieval (CLIR).

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Jurafsky, Martin, 2nd Edition, 2013, Pearson Education India.
2. Statistical Natural Language Processing, Manning and Schutze, 1st Edition, 1999, MIT Press.
3. Python 3 text processing with NLTK 3 cookbook, Jacob Perkins, 2014, Packt Publishing Ltd.

Reference Books:

1. Foundations of Statistical Natural Language Processing, Manning, Christopher, Heinrich, Schutze, 1999, MIT Press.
2. Speech and Language processing, Daniel Jurafsky, James H. Martin, 2008, Prentice Hall.
3. Statistical Methods for Speech Recognition, Jelinek, F., 1998, The MIT Press.
4. Elements of Information Theory, J. A. Thomas, 2nd Edition, 1991, Wiley.

Course Code	Course Title	Hour/Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD604P	NLP for Indian Languages Lab	-	-	2	1	25	25	50	-

Course Objective
The lab course enables the learners to implement various models, core algorithms for processing Indian languages using different tools that enhances their technical and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Make use of various machine learning algorithms suitable for NLP.
CO2	**Apply:** Apply various techniques of Lexical analysis, Sentence Framing, Part-of-Speech (POS) tagging and Semantics in text generation.
CO3	**Analyze:** Analyze the morphological diversity of Indian languages and implement dependency parsing and text classification for NLP applications.
CO4	**Create:** Construct program based on different techniques for Indian Language Understanding.

A minimum of eight practical to be performed based on the theory course of course NLP for Indian Languages [PECAD604T]

Suggested References:
1. Speech and Language Processing, D. Jurafsky, J.H. Martin, 3rd Online Edition.
2. Introduction to Natural Language Processing, J. Eisenstein, 2019, MIT Press.
3. Python 3 text processing with NLTK 3 cookbook, Jacob Perkins, 2014, Packt Publishing Ltd.
4. Foundations of Statistical Natural Language Processing, C. D. Manning, H. Schutze, 1st Edition, 1999, MIT Press.
5. Natural Language Understanding, J. Allen, 2nd Edition, 2003, Pearson Education.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD605T	Cryptography	3	-	-	3	40	60	100	3

Course Objective

The course will enable the students to understand various cryptographic methods to secure data, technologies for security assurance and security solutions that enhances employability and technical skills.

Course Outcomes

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

CO1	**Understand:** Outline the risk related to computer security and information hazards in various situation.
CO2	**Apply:** Make use of cryptographic algorithm and protocol to secure computer system and data.
CO3	**Analyse:** Analyse various cipher techniques, hash functions algorithms and digital signatures.
CO4	**Evaluate:** Determine measures to prevent attacks on network using various cryptographic solutions.
CO5	**Create:** Discuss various authentication systems and information security compliance standards.

SYLLABUS

UNIT I: Introduction and Classical Ciphers
Computer Security, Information Security, Network Security, CIA Triad, Cryptography, Cryptosystem, Cryptanalysis, Active attack, Passive Attack, Authentication, Access Control, Classical Cryptosystems, Caesar Cipher, Playfair Cipher, Hill Cipher, Rail Fence Cipher, Modern Block Ciphers, Stream Ciphers, Symmetric Ciphers, Asymmetric Ciphers.

UNIT II: Symmetric Ciphers
Data Encryption Standards, Double DES, Meet in Middle Attack, Triple DES, Advanced Encryption Standards, Modes of Block Cipher Encryptions, Electronic Code Book, Cipher Block Chaining, Cipher Feedback Mode, Output Feedback Mode, Counter Mode.

UNIT III: Asymmetric Ciphers
Public Key Cryptosystems, Applications of Public Key Cryptosystems, Distribution of public key, Distribution of secret key by using public key cryptography, Diffie Hellman Key Exchange, Man-in-the-Middle Attack, RSA Algorithm, Elliptic curve cryptography.

UNIT IV: Hash Functions and Digital Signatures
Message Authentication, Message Authentication Functions, Message Authentication Codes, Hash Functions, Properties of Hash functions, Applications of Hash Functions, Message Digests: Details of MD4 and MD5 algorithms, Secure Hash Algorithms: Details of SHA-1 and SHA-2 algorithms, Comparison of SHA parameters, SHA-512, Digital Signatures.

UNIT V: Authentication and Malicious Logic
Authentication System, Password Based Authentication, Dictionary Attacks (Online and Offline), Challenge Response System, One Way Authentication, Mutual Authentication, Biometric System, Kerberos Protocol.

UNIT VI: Public Key Infrastructure
Digital Certificates and X.509 certificates, Certificate Life Cycle Management, PKI trust models, Email Security: Pretty Good Privacy, Secure Socket Layer Protocol, Transport Layer Security Protocol, IP Security (IPSec) Protocol, Firewalls.

Text Books:

1. Cryptography and Network Security Principles and Practices, William Stallings, 5th Edition, 2002, Pearson.
2. Network Security and Cryptography, Bernard Menezes, 1st Edition, 2010, Cengage Learning.

Reference Books:

1. Network Security, Charlie Kaufman, Radia Perlman and Mike Speciner, 2002, Prentice Hall.
2. Network Security: The Complete Reference, Robert Bragg and Mark Rhodes, 2004, Tata McGraw Hill.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD605P	Cryptography Lab	-	-	2	1	25	25	50	-

Course Objective
The lab course will encourage students to use various open-source security tools and algorithms to improve information and network security that enhance employability and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Make use of cryptographic algorithm and protocol to secure computer system and data.
CO2	**Analyse:** Analyse various cipher techniques, hash functions algorithms and digital signatures.
CO3	**Evaluate:** Assess various cipher algorithms, Hash algorithms, Authentication system and public key infrastructure for developing a secure system.
CO4	**Create:** Develop applications using various Ciphers and Hash Algorithms to secure message.

A minimum of eight practical to be performed based on the theory course of Cryptography [PECAD605T]

Suggested References:
1. Network Security, Charlie Kaufman, Radia Perlman and Mike Speciner, 2002, Prentice Hall.
2. Network Security: The Complete Reference, Robert Bragg and Mark Rhodes, 2004, Tata McGraw Hill.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD606T	Big Data Analytics and Business Intelligence	3	-	-	3	40	60	100	3

Course Objective
The course enables the students to understand the storage, retrieval and processing of big data and perform a variety of analytics on different data sets that enhances employability and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Interpret the concept of Big Data, technologies and its analytics in the real world.
CO2	**Analyse:** Analyse the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.
CO3	**Apply:** Make use of suitable algorithms to solve data intensive problems using Map Reduce Paradigm.
CO4	**Understand:** Illustrate the concept of Business Intelligence, its Framework, project lifecycle and application of BI in the real world.
CO5	**Analyse:** Analyse different data integration techniques for integration of data with business to improve the business process.

SYLLABUS
UNIT I: Introduction to Big Data and Data Analytics Big Data: Classification of Digital Data, Structured and Unstructured Data, Big Data: Characteristics, Evolution, Definition, Challenges with Big Data Need of Big Data, Traditional Business Intelligence versus Big Data, Data Warehouse and Hadoop Environment. Big Data Analytics: Classification of Analytics, Challenges, Big Data Analytics, Data Science, Data Scientist, Terminologies used in Big Data Environments.
UNIT II: The Technology Landscape NoSQL, Comparison of SQL and NoSQL, Hadoop, RDBMS Versus Hadoop, Distributed Computing Challenges, Hadoop Overview, Hadoop Distributed File System, Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN, Interacting with Hadoop Ecosystem.
UNIT III: Introduction to Mongodb and Mapreduce Programming MongoDB, Need, Terms used in RDBMS and Mongo DB, Data Types, MongoDB Query Language. MapReduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting.

UNIT IV: Introduction to Business Intelligence
Evolution of BI, BI value chain, introduction to business analytics, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities.

UNIT V: Basics of Data Integration
Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, data integration technologies, Introduction to data quality, data profiling concepts and applications, the multidimensional data model, star and snowflake schema.

UNIT VI: BI Project Lifecycle
Typical BI Project Lifecycle, Requirements Gathering and Analysis - Functional and Non-Functional Requirements, Project Development, Testing in a BI Project, BI Project Deployment, Post Production Support.

Text Books: [Check textbooks]

1. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, 1st Edition, 2015, Wiley Publications.
2. Big Data Analytics with R and Hadoop, Vignesh Prajapati,1st Edition, 2013, Packet Publishing Limited.
3. Fundamentals of Business Analytics, R N Prasad and S Acharya, 2nd Edition, 2011, Wiley India.

Reference Books:

1. Business Intelligence - A Managerial Approach, Efraim Turban, Ramesh Sharda, Dursun Delen, David King, 2nd Edition 2010, Prentice Hall.
2. HADOOP: The definitive Guide, Tom White, 3rd Edition, 2012, O'Reilly.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
PECAD606P	Big Data Analytics and Business Intelligence Lab	-	-	2	1	25	25	50	-

Course Objective
The lab course enables the students to optimize business decisions and create competitive advantage with big data analytics that enhance employability and entrepreneurship skills.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Apply:** Make use of the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.
CO2	**Apply:** Make use of suitable algorithms to solve data intensive problems using Map Reduce Paradigm.
CO3	**Apply:** Apply the concept of Business Intelligence, its Framework, project lifecycle and application of BI in the real world.
CO4	**Create:** Design a data analytics project by applying all phases of project lifecycle.

A minimum of eight practical to be performed based on the theory course of course Big Data Analytics and Business Intelligence [PECAD606T]

Suggested References:

1. Business Intelligence - A Managerial Approach, Efraim Turban, Ramesh Sharda, Dursun Delen, David King, 2nd Edition, 2010, Prentice Hall.
2. HADOOP: The definitive Guide, Tom White, 3rd Edition, 2012, O'Reilly.

Course Code	Course Title	Hour / Week			Credits	Maximum Marks			ESE
		L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs.)
OECAD601T	Business Analytics	3	-	-	3	40	60	100	3

Course Objective
The course enables the students to learn the concepts of business analytics to cope up with the current business scenario by enhancing their analytical skills as business professionals.

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	**Understand:** Outline the importance of business analytics and understand the issues, challenges, types, techniques and emerging trends of business analytics.
CO2	**Apply:** Apply different phases of analysis process to the business analytics problem to get better understanding of the project/business.
CO3	**Apply:** Make use of different dashboard design concepts for effective dashboard design and data mining tools for big data analysis.
CO4	**Analyse:** Categorize the types of analytics, tools for data mining and big data analysis for the future of Business Intelligence.
CO5	**Understand:** Interpret the Technologies, Software, Services and Applications of big data for Business Intelligence.

SYLLABUS
UNIT I: Overview of Business Analytics Value of Business Analytics, Introduction to business analytics, Challenges, Techniques and Issues, Emerging Trends, Producing Insights from Information through Analytics, Organization/sources of data, Importance of data quality, Dealing with missing or incomplete data.
UNIT II: Types of Analytics Types of Analytics and the Benefits, Typical Application to Business Problems, Descriptive Analytics, Predictive Analytics, Text Analytics, Prescriptive/Optimization Analytics, Mixed Predictive/Optimization Analytics, Case Studies.
UNIT III: The Analytics Process Phases in Analysis process, Business Understanding, Data Understanding, Data Preparation, Exploration, Modelling, Evaluation, Deployment, Monitoring and Sustainment.

UNIT IV: Business Intelligence (BI)

Evolution of BI, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Intelligence-case studies.

UNIT V: Basics of Power BI and Data Modelling

Introduction, Installation Steps, Architecture, Supported Data Sources, File, Database, Using DirectQuery, Power Pivot, Connecting with Azure and other online services, Comparison with Other BI Tools Data Modelling, Navigation, Creating Calculated Columns, Creating Calculated Tables, Managing Time-Based Data.

UNIT VI: Visualization and Dashboard Design using Power BI

Dashboard Options, Visualization Options, Excel Integration, Importing xls Files, Using xls data.Reports, Scorecards, and Dashboards, Dashboard Structure, Dashboard Types Indicators, Effective Dashboard Design, Dashboard Media, Dashboard trends, DAX Basics in Power BI.

Text Books:

1. Business Analytics an Introduction, Jay Liebowitz, 1st Edition, 2013, Auerbach Publication.
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston, 5th Edition, 2015, Cengage Learning.
3. Beginning Power BI with Excel 2013: Self-Service Business Intelligence Using Power Pivot, Power View, Power Query, and Power Map, Dan Clark, Apress.

Reference Books:

1. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Gert H. N. Laursen, Jesper Thorlund, 2nd Edition, 2010, Wiley Publication.
2. Business Analytics: An Application Focus3.75, Purba Halady Rao, 2013, PHI Learning.
3. Power Pivot and Power BI: The Excel User's Guide to DAX Power Query, Power BI & Power Pivot in Excel 2010-2016, Rob Collie, Avi Singh, 2016, Holy Macro! Books.

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