SYLLABUS

(With effect from 2024 -25)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2024-25)

Bachelor Degree
In

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

V & VI Semester

Out Come Based Education
With
Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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VISION

"To develop skilled professionals in the field of Artificial Intelligence & Machine Learning contributing globally to the benefit of industry and society."

MISSION

- *To impart knowledge in cutting edge Artificial Intelligence technologies that meets industry standards.*
- *Tocollaborate with industry to uplift innovative research and development in Artificial Intelligence & Machine Learning and related domains to meet societal demands.*
- *To produce successful Computer Science and Engineering graduates with a specialization in Artificial Intelligence & Machine Learning with personal and professional responsibilities, and a commitment to lifelong learning.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Computer Science and Engineering (AI & ML)

The Vision of the department is:

"To develop skilled professionals in the field of Artificial Intelligence & Machine Learning contributing globally to the benefit of industry and society".

The mission of the department is:

DM1: To impart knowledge in cutting edge Artificial Intelligence technologies that meets industry standards.

{Required to create professionally competent engineers}

DM2: To collaborate with industry to uplift innovative research and development in Artificial Intelligence & Machine Learning and related domains to meet societal demands.
{Required to create professionally competent engineers and socially responsible engineers}

DM3: To produce successful Computer Science and Engineering graduates with a specialization in Artificial Intelligence & Machine Learning with personal and professional responsibilities and a commitment to lifelong learning.
{Required to create professionally competent engineers}

Program Educational Objectives (PEOs)

PEO1: Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Artificial Intelligence and Machine Learning.

PEO2: Graduates will be able to pursue higher education in reputed institutions with AI Specialization.

PEO3: Graduates will have the ability to explore research areas and produce outstanding contribution in various areas of Artificial Intelligence and Machine Learning.

PEO4: Graduates will be ethically and socially responsible solution providers and entrepreneurs in the field of Computer Science and Engineering with AI/ML Specialization.

The National Board of Accreditation (NBA) has defined twelve Program Outcomes for Under Graduate (UG) engineering programs as listed below.

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problem.
2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess Societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The Under Graduate (UG) of B.E Computer Science & Engineering Program has defined **Program Specific Outcomes (PSO**) which are listed below.

PSO1: Apply the knowledge of programming and designing algorithms to develop solutions for engineering problems pertaining to AI&ML

PSO2: Analyse and develop models in Machine Learning, Deep Learning using knowledge of AI and modern tools.

	Bachelor of Engineering – CSE [AIML] (V–Semester)										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs/Week				Credits	Examination Marks		
				L	T*	P	PJ		CIE	SEE	Total
1	P22AI501	Software Engineering & ProjectManagement	CS/AIML	3	-	-	-	3	50	50	100
2	P22AI502	Automata Theory and CompilerDesign	CS/AIML	2	1	-	-	3	50	50	100
3	P22AI503	Professional Core (Elective)	CS/AIML	3	-	-	-	3	50	50	100
4	P22AI504	High performance computing(Integrated)	CS/AIML	3	-	2	-	4	50	50	100
5	P22AI505	Machine Learning	CS/AIML	3	-	-	-	3	50	50	100
6	P22AIL506	Machine Learning Laboratory	CS/AIML	-	-	2	-	1	50	50	100
7	P22INT507	Internship-II	XX	-	-	-	-	2	-	100	100
8	P22HSMC508B	Employability Enhancement Skills–V	HSMC	1	-	-	-	1	50	50	100
9.	P22UHV509	Social Connect and Responsibility	ANY DEPT	1	-	-	-	1	50	50	100
	Total							21			

Professional Elective Course–I(P22AI503X)	
Course Code	**Course Title**
P22AI5031	Java Programming
P22AI5032	Block chain Technology
P22AI5033	Managing Big Data
P22AI5034	Computer Graphics and Fundamentals of Image Processing

	Bachelor of Engineering – CSE [AIML] (VI–Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs/Week**				**Credits**	**ExaminationMarks**		
				L	**T***	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P22AI601	Natural Language Processing	CS/AIML	2	1	-	-	3	50	50	100
2	P22AI602	Professional Core Course (Elective)	CS/AIML	3	-	-	-	3	50	50	100
3	P22AI603	Professional Core Course (Elective)	CS/AIML	3	-	-	-	3	50	50	100
4	P22AI604	Advanced Machine Learning	CS/AIML	3	-	2	-	4	50	50	100
5	P22AI605	Open Elective–II	CS/AIML	3	-	-	-	3	50	50	100
6	P22AIL606	Natural Language ProcessingLaboratory	CS/AIML	-	-	2	-	1	50	50	100
7	P22AIMP607	Mini–Project	CS/AIML	-	-	2	2	2	50	50	100
8	P22HSMC608B	Employability Enhancement Skills-VI	HSMC	1	-	-	-	1	50	50	100
9.	P22UHV609	Universal Human Values andProfessional Ethics	ANY DEPT	1	-	-	-	1	50	50	100
	Total							**21**			

Professional Elective Course – II(P21XX602X)		**Professional Elective Course – III (P21XX603X)**		**Open Elective – II (P21XXO605X)**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
P22AI6021	Full Stack Development	P22AI6031	Fundamentals of DevOp's	P22AIO6051	Fundamentals of Artificial Intelligence
P22AI6022	Cloud Computing	P22AI6032	IoT Communication Protocols	P22AIO6052	Fundamentals of Machine Learning
P22AI6023	Business Intelligence and its application	P22AI6033	Robotics Process Automation-Design and Development	P22AIO6053	Fundamentals of Natural Language processing
P22AI6024	Computer Vision	P22AI6034	Augmented Reality and Virtual Reality	P22AIO6054	Introduction to Full Stack Development

Software Engineering and Project Management [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P22AI501**	**Credits:**	**03**
Teaching Hours/Week (L: T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Introduction to Software Engineering.
2. Describe the process of Agile Software Engineering, the technologies used for Software Engineering, and configuration management of Software Engineering.
3. Apply Object oriented Design decisions, Patterns and Software testing.
4. Understand Software Project management and Configure management.
5. Explain Earned Value Management (EVM) and its basics.

UNIT – I	**Overview**	**8 Hours**

OVERVIEW: Introduction to Software Engineering, Introduction, Professional software development.

Software processes: Software process models, Process activities, coping with change, The Rational Unified Process.

Self-study component:	Software Engineering Ethics

UNIT – II	**Agile and Lean Software development**	**8 Hours**

Agile software development: Agile methods, Plan driven and agile development, Extreme programming, Agile project management, Scaling agile methods.

Lean Software Development (LSD): Eliminating the waste, Fast Delivery, Amplify Learning, Builds Quality, Respect Teamwork, Delay the commitment, optimizing the whole system, Difference between Lean Development Model and Agile Development Model.

Self-study component:	EVO function specification using language

UNIT – III	**Design and Implementation**	**8 Hours**

Design and Implementation: Object-oriented design using the UML Design patterns, Implementation issues, Open-source development.

Software testing: Development testing, Test-driven development, Release testing, User testing.

Self-study component:	Control styles in design

UNIT – IV	**Project and Configuration Management**	**8 Hours**

Software Project Management (SPM): Conflict Management, Risk Management, Requirement Management, Managing people, Teamwork.

Configuration management: Change management, Version management System building, Release management

Self-study component:	Software measurements and Metrics

UNIT – V	**Earned Value Management (EVM)**	**8 Hours**

Earned Value Management (EVM): Benefits of EVM, Planned Value (PV), Actual Costs (AC), Earned Value (EV). Variance Analysis, Performance Indexes.

Fundamentals of Earned Value Management: Organization and Scope of Project, Planning, Scheduling, and Budgeting, Accounting for Actual Costs, Analysing and Reporting on Project Performance, Revisions and Data Maintenance, Find the Best EVM Solution for Your Projects.

Self-study component:	Different Earned value formulas

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explore** the various types of software process models	Remember	L1
CO2	**Elaborate** the importance of software development.	Understanding	L2
CO3	**Asses** the significance of software engineering design and development	Understanding	L2
CO4	**Derive** different Software project management methods	Applying	L3
CO5	**Solve various** Earned Value Management techniques	Applying	L3

Textbook(s):

1. **Software Engineering** – Ian Somerville, 10th Edition, ©2016 | **Pearson**.
2. **Earned value Project Management by** Quentin W. Fleming PhD MSc and Joel M. Koppelman, fourth Edition 2010, PMI

Reference Book(s):

1. Agile and Iterative Development by Craieg Larman 2003
2. **Software Engineering: A Practitioners Approach -** Roger S. Pressman, 7th Edition,
3. McGraw-Hill, 2007.
4. **Software Engineering Theory and Practice -** Shari Lawrence Pfleeger, Joanne M.
5. Atlee, 3rd Edition, Pearson Education, 2006.
6. **Software Engineering Principles and Practice –** Waman S Javadekar, Tata McGraw Hill, 2004
7. **Software Engineering** – Pankaj Jalote, Tata McGraw Hill

Automata Theory and Compiler Design

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P22AI502**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2:1:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1. Introduce the fundamental concepts of Automata Theory, Formal Languages and compiler design CLO 2. Principles Demonstrate Application of Automata Theory and Formal Languages in the field of compiler design

CLO 3. Develop understanding of computation through Push Down Automata and Turing Machines

CLO 4. Introduce activities carried out in different phases of Phases compiler

CLO 5. Identify the undecidability problems.

UNIT – I	**8 Hours**

Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion.

Introduction to Compiler Design: Language Processors, Phases of Compilers

Textbook 1: Chapter1 – 1.5, Chapter2 – 2.2,2.3,2.5 Chapter4 –4.4

Textbook 2: Chapter1 – 1.1 and 1.2

Self-study component:	Minimization of DFA

UNIT – II	**8 Hours**

Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Proving Languages Not to Be Regular

Lexical Analysis Phase of compiler Design: Role of Lexical Analyzer, Input Buffering, Specification of Token.

Textbook 1: Chapter3 – 3.1, 3.2, Chapter4- 4.1

Self-study component:	Recognition of Token.

UNIT – III	**8 Hours**

Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion.

Syntax Analysis Phase of Compilers: part-1: Role of Parser , Top-Down Parsing

Textbook 1: Chapter 5 – 5.1.1 to 5.1.6, 5.2 (5.2.1, 5.2.2), 5.4

Textbook 2: Chapter 4 – 4.1, 4.2, 4.3 (4.3.2 to 4.3.4) ,4.4

Self-study component:	Left Factoring

UNIT – IV	**8 Hours**
Push Down Automata: Definition of the Pushdown Automata, The Languages of a PDA. **Syntax Analysis Phase of Compilers:** Part-2: Bottom-up Parsing, Introduction to LR Parsing: SLR. Textbook1: Chapter 6 – 6.1, 6.2 Textbook2: Chapter 4 – 4.5, 4.6, 4.7 (Up to 4.7.4)	
Self-study component:	More Powerful LR parsers
UNIT – V	**8 Hours**
Introduction to Turing Machine: Problems that Computers Cannot Solve, The Turing machine, problems, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine **Undecidability:** A language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE. **Other Phases of Compilers:** Syntax Directed Translation- Syntax-Directed Definitions, Evaluation Orders for SDD's. Intermediate-Code Generation- Variants of Syntax Trees, Three-Address Code. Textbook1: Chapter 8 – 8.1, 8.2,8.3,8.4 Chapter 9 – 9.1,9.2 Textbook2: Chapter 5 – 5.1, 5.2, Chapter 6- 6.1,6.2 Chapter 8- 8.1	
Self-study component:	Code Generation- Issues in the Design of a Code Generator

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation	Understanding	L2
CO2	Design and develop lexical analysers, parsers and code generators	Create	L6
CO3	Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.	Create	L6
CO4	Acquire fundamental understanding of the structure of a Compiler and Apply concepts automata theory and Theory of Computation to design Compilers	Understanding	L2
CO5	Design computations models for problems in Automata theory and adaptation of such model in the field of compilers	Create	L6

Textbook(s):

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson.
2. Alfred V.Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles, Techniques and Tools", Second Edition, Pearson.

Reference Book(s):

1. Elain Rich, "Automata, Computability and complexity", 1st Edition, Pearson Education,2018.
2. K.L.P Mishra, N Chandrashekaran , 3rd Edition , 'Theory of Computer Science",PHI,2012.
3. Peter Linz, "An introduction to Formal Languages and Automata ", 3rd Edition, Narosa Publishers,1998.
4. K Muneeswaran," Compiler Design", Oxford University Press 2013.

Java Programming
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P22AI5031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Demonstrate the OOP Concepts using Java.
- Illustrate the concept of Interfaces, Packages, Exception, Multithreading and Generics in Java.
- Understand the java applets and event handling.
- Development of Java Application using the concept of Abstract Window Toolkit and swings

UNIT – I **8 Hours**

Getting Started with Java: Principles of Object-Oriented Languages, Java Virtual Machine.

Classes and Objects: Classes. Objects, Class Declaration in Java, Creating Objects, Methods, Constructors, Cleaning Up Unused Objects, Class Variable and Methods—Static Keyword, this Keyword.

Inheritance: Inheritance vs Aggregation, Overriding Method, super Keyword, final Keyword, Abstract Class

Text Book – 1: Chapter 1 (1.3), Chapter 2 (2.5 – 2.6), Chapter 4 (4.1 – 4.9), Chapter 5 (5.1 – 5.5)

Self-study component:	Java Features
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II **8 Hours**

Interfaces and Packages: Interfaces, Packages.

Exception: Introduction, Exception Handling Techniques, User-Defined Exception.

Multithreading in Java: Introduction, Multithreading in Java, java.lang.Thread, Main Thread, Creation of New Threads.

Generics: Introduction, Generics.

Text Book – 1: Chapter 6 (6.1 – 6.2), Chapter 7 (7.1 – 7.3), Chapter 8 (8.1 – 8.6), Chapter 10 (10.1 – 10.2)

Self-study component:	Thread. State in Java.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	8 Hours

Applets: Introduction, Applet Class, Applet Class, Applet Structure, Example Applet Program, Applet Life Cycle, Common Methods Used in Displaying the Output, paint(), update(), and repaint(),More About Applet Tag, NetDocuments's() and get Codebase() Methods, Applet context Interface, How To Use An Audio Clip?, Images in Applet, Graphics Class, Color, Font, Font metrics.

Event Handling in Java: Introduction, Event Delegation Model, java.awt.Event Description, Sources of Events, Event Listeners, How Does The Model Work?, Adapter Classes, Inner Classes in Event Handling

Text Book – 1: Chapter 12 (12.1 – 12.17), Chapter 13 (13.1 – 13.8)

Self-study component:	Practical Problem: Digital Clock
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	8 Hours

Abstract Window Toolkit: Introduction, Components and Containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Text field and Text area, Container Class, Layouts, Menu, Scrollbar

Text Book – 1: Chapter 14 (14.1 – 14.14)

Self-study component:	Practical Problem: City Map Applet
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	8 Hours

Swing: Introduction, JFrame, JApplet, Janel, Components in Swings, Layout Managers, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, JFileChooser, JColorChooser, Pluggable Look and Feel, Inner Frames.

Textbook – 1: Chapter 15 (15.1 – 15.17)

Self-study component:	Practical Problem: Mini Editor

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Apply the knowledge of Java Programming to demonstrate the OOP Concepts.	Apply	L3
CO2	Demonstrate the concept of Interfaces, Packages, Exception, Multithreading and Generics in Java.	Analyse	L3
CO3	Develop Java Program for applets and event handling.	Create	L6
CO4	Apply Abstract Window Toolkit for the development of Java application.	Apply	L3
CO5	Apply Swing for the development of Java application.	Apply	L3

Textbook:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java" 2nd Edition, Oxford University Press, 2016

Reference book(s):

1. Herbert Schildt, "The Complete Reference Java" Seventh Edition, TataMcGraw-Hill,2007
2. H.M. Deitel, "Java –How to Program? ",PrenticeHall,2004.

Block Chain Technology
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P22AI5032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Prerequisites:

- Knowledge of data structures.
- Students must have knowledge of some programming languages (such as C, C++, and Java)

Course Learning Objectives: This course will enable the students to:

- Understand how blockchain systems (mainly Bitcoin and Ethereum) work.
- Design, build, and deploy smart contracts and distributed applications.
- Integrate ideas from blockchain technology into their own projects

UNIT – I	**8 Hours**

Introduction: Blockchain, Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain.

Decentralization and Cryptography: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized Organizations.

Self-study component:	Benefits and limitations of blockchain

UNIT – II	**8 Hours**

Cryptographic primitives: Symmetric cryptography, Stream ciphers, Block ciphers, Block encryption mode, Keystream generation modes, Message authentication modes, Electronic code book, Cipher block chaining, Counter mode, Data Encryption Standard (DES) Advanced Encryption Standard (AES), Asymmetric cryptography; Public and private keys, Encryption and decryption using RSA, Cryptographic Hash Function, Merkle tree, Digital signatures :Sign then encrypt, Encrypt then sign,.

Self-study component:	Properties of a hash function

UNIT – III	**8 Hours**

Bitcoin - Introduction, Transactions, Transactions Structure, Transactions types, Blockchain- The structure of a block, The genesis block, The bitcoin network, Wallets and its types, Bitcoin payments, Bitcoin investment and

buying and selling bitcoins, Bitcoin programming and the command-line interface, Bitcoin improvement proposals (BIPs).

Self-study component:	Bitcoin installation

UNIT – IV	**8 Hours**

Ethereum: Ethereum block chain, Elements of the Ethereum block chain, Precompiled contracts, Accounts and its types, Block header, Ether ,Messages, Mining ,Clients and wallets ,Trading and investment , The Ethereum network ,Applications developed on Ethereum.

Introducing solidity: Types, value types-Boolean, Integers, Address, Literals, Function types, Reference Types-Arrays, Structs, Mappings, Global variables, Control structures, Events, Inheritance, Libraries, Functions.

Self-study component:	The yellow paper

UNIT – V	**8 Hours**

Smart Contract: History of Smart Contract, Ricardian contracts, Deploying smart contracts on a blockchain, The DAO.

Hyperledger: projects, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth Lake, Corda Architecture.

Self-study component:	Corda Components

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain the basic concepts and technology used for blockchain.	Understanding	L2
CO2	Describe the primitives of the distributed computing and cryptography related to blockchain.	Understanding	L2
CO3	Illustrate the concepts of Bitcoin and their usage.	Apply	L3
CO4	Analyse the working of Ethereum.	Analyse	L4
CO5	Describe smart contract , Hyperledger fabric and its framework, design principles and architecture	Understanding	L2

Text Book(s):

1. Imran Bashir, "Mastering Block Chain: Distributed Ledgers, Decentralization and Smart Contracts Explained", 2017, Packet Publishing.

Reference Book(s):

1. Melanic Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015.
2. Josh Thompsons, "Block Chain: The Block Chain for Beginners-Guide to Block chain Technology and Leveraging Block Chain Programming".
3. Daniel Drescher, "Block Chain Basics", Après; 1st edition, 2017.
4. Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi.
5. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain", Packet Publishing.

Managing Big Data

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P22AI5033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Explore and apply the Big Data analytic techniques for business applications.

CLO2: Discuss the overview of Apache Hadoop.

CLO3: Able to implement basic technologies that forms the foundations of Big Data.

UNIT – I	**8 Hours**

Introduction to Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing,Volunteer Computing, In memory Data Base.

Hadoop Distributed File system: The Design of HDFS, HDFS Concepts: Blocks, Name nodes and Data nodes, HDFS Federation, HDFS High-Availability, Basic File system Operation, Reading Data from a Hadoop URL.

Data Flow: Anatomy of a File Read, Anatomy of a File Write.

Self-study component:	Reading and Writing Data using File system.

UNIT – II	**8 Hours**

YARN: Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness.

Hadoop I/O: Data Integrity, Data Integrity in HDFS, Local File System, Checksum File System, Compression, Codecs, Compression and Input Splits, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks.

Self-study component:	File-Based Data Structures: Sequence File, Map File, Other File formats and Column – Oriented Formats.

UNIT – III	**8 Hours**

Developing a MapReduce Application: The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, writing a Unit Test with MR Unit: Mapper, Reducer, Running Locally on Test Data, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, Job Control, Apache Oozie.

How MapReduce Works: Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, Task Execution.

Self-study component:	Running on a Cluster, Hadoop Logs.

UNIT – IV	**8 Hours**

MapReduce Types and Formats: MapReduce Types, Input Formats: Input Splits and Records Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output.

Flume: Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Sink Groups, Integrating Flume with Applications, Component.

Self-study component:	Installing Flume, An Example, Distribution: Agent Tiers, Delivery Guarantees.

UNIT – V	**8 Hours**

Pig: Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, And An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data.

Spark : Installing Spark, An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution.

Self-study component:	Spark Executors and Cluster Managers: Spark on YARN.

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understanding big data concepts and Hadoop Distributed File System	L1	Understand
CO2	Design big data applications using the comprehensive concepts of YARN and Hadoop I/O operations.	L4	Design
CO3	Develop, debug, and optimize MapReduce applications to understand the mechanisms of MapReduce job execution.	L3	Apply
CO4	A comprehensive understanding of Apache Flume, Apache Pig, and Apache Spark to process and analyze large datasets effectively.	L2	Analyse

Text Book(s):

1. Hadoop: The Definitive Guide, Tom White, O'Reilly, Third Edition, 2012.

Reference Book(s):

1. SPARK: The Definitive Guide, Matei Zaharia and Bill Chambers, Oreilly, 2018
2. Apache Flume: Distributed Log Collection for Hadoop, D'Souza and Steve Hoffman Oreilly, 2014

Web and Video link(s):

1. https://www.tutorialspoint.com/big_data_tutorials.html
2. https://www.digimat.in/nptel/courses/video/106104189/L01.html

Computer Graphics and Fundamentals of Image Processing
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P22AI5034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1. Overview of Computer Graphics along with its applications.
CLO 2. Exploring 2D and 3D graphics mathematics along with OpenGL API's.
CLO 3. Use of Computer graphics principles for animation and design of GUI's.
CLO 4. Introduction to Image processing and Open CV.
CLO 5. Image segmentation using Open CV.

UNIT – I **8 Hours**

Overview: Computer Graphics hardware and software and OpenGL: Computer Graphics: Video Display Devices, Raster-Scan Systems Basics of computer graphics, Application of Computer Graphics. OpenGL: Introduction to OpenGL, coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms(DDA, Bresenham's).

Textbook 1: Chapter -1,2,3, 5(1 and 2 only)

Self-study component:	Input devices, hard copy devices, coordinate representation, graphics functions, fill area primitives, polygon fill areas, pixel arrays, Parallel Line algorithms

UNIT – II **8 Hours**

2D and 3D graphics with OpenGL: 2D Geometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates, 2D Composite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, OpenGL geometric transformations function, 3D Geometric Transformations: Translation, rotation, scaling, composite 3D transformations, other 3D transformations, OpenGL geometric transformations functions.

Textbook 1: Chapter -6, 8

Self-study component:	Transformation between 2D coordinate system, OpenGL geometric transformation, Transformation between 3D coordinate system.

UNIT – III **8 Hours**

Interactive Input Methods and Graphical User Interfaces: Graphical Input Data, Logical Classification of Input Devices, Input Functions for Graphical Data, Interactive Picture Construction Techniques, Virtual-Reality Environments, OpenGL Interactive Input-Device Functions, OpenGL Menu Functions, Designing a Graphical User Interface.
Computer Animation: Design of Animation Sequences, Traditional Animation Techniques, General Computer-Animation Functions, Computer-Animation Languages, Character Animation, Periodic Motions, OpenGL Animation Procedures.
Textbook 1: Chapter -11, 18

Self-study component:	Raster methods for computer animation, Key frame systems, Motion specification.

UNIT – IV	**8 Hours**

Introduction to Image processing: overview, Nature of IP, IP and its related fields, Digital Image representation, types of images.
Digital Image Processing Operations: Basic relationships and distance metrics, Classification of Image processing Operations.

Text book 2: Chapter 3

Self-study component:	**Computer vision and OpenCV:** What is computer vision, Evolution of computer vision, Application of Computer vision, Feature of OpenCV

UNIT – V	**8 Hours**

Image Segmentation: Introduction, classification, detection of discontinuities, Edge detection (up to canny edge detection(included)).

Text Book 2: Chapter 9: 9.1 to 9.4.4.4

Self-study component:	**Image processing with Open CV:** Resizing , Rotation/ Flipping, Blending, Creating region of Interest (ROI)

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Construct geometric objects using Computer Graphics principles and OpenGL APIs.	Create	L6
CO2	Use OpenGL APIs and related mathematics for 2D and 3D geometric Operations on the objects.	Apply	L4
CO3	Design GUI with necessary techniques required to animate the created objects	Create	L6
CO4	Apply OpenCV for developing Image processing applications.	Apply	L4
CO5	Apply Image segmentation techniques along with programming, using OpenCV, for developing simple applications.	Apply	L4

Textbook:

1. Donald D Hearn, M Pauline Baker and Warren Carithers: Computer Graphics with OpenGL 4th Edition, Pearson, 2014
2. S. Sridhar, Digital Image Processing, second edition, Oxford University press 2016.

Reference book(s):

1. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

Web and Video link(s):

1. https://nptel.ac.in/courses/106/106/106106090/
2. https://nptel.ac.in/courses/106/102/106102063/
3. https://nptel.ac.in/courses/106/103/106103224/
4. https://nptel.ac.in/courses/106/102/106102065/
5. https://www.tutorialspoint.com/opencv/ (Tutorial, Types of Images, Drawing Functions)

High Performance Computing

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P22AI504**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40 + 20**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Provides a solid foundation in High Performance Computing (HPC) and its role in science and engineering.
2. To study the fundamental techniques for developing HPC applications, the commonly used HPC platforms, the methods for measuring, assessing and analysing the performance of HPC applications.

UNIT – I	**8 Hours**

Introduction to High–Performance Computers, CPU Design: Reduced Instruction Set Computers, Multiple–Core Processors, Vector Processors, Parallel Semantics, Distributed Memory Programming

Self-study component:	Memory Hierarchy

UNIT – II	**8 Hours**

Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API, Thread Creation and Termination, Synchronization Primitives in Threads, Controlling Thread and Synchronization Attributes, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming

Self-study component:	Thread Cancellation

Practical components

OPENMP PROGRAMS

1. Write an OpenMP program to add all the elements of two arrays A & B each of size 1000 and store their sum in a variable using reduction clause.
2. Write an OpenMP program to multiply two matrices A & B and find the resultant matrix C.
3. Write an OpenMP program to find the number of processors, number of threads, etc (the environment information).
4. Write an OpenMP program to print all the letters of the alphabet A-Z using threads.
5. Write an OpenMP program to show how thread private clause works

UNIT – III	**8 Hours**

Programming using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation.

Self-study component:	Collective Communication and Computation Operations

Practical components

MPI PROGRAMS

1. Write a MPI program to send the message from a process whose rank=3 to all other remaining processes.

2. Write a MPI program where each processor sends an integer number and its rank to the master processor, where the master gathers all the information and prints the data accordingly.

3. Write a MPI program to broadcast a message.

4.Write a MPI program to find sum of 'n' integers on 'p' processors using point-to-point communication libraries call.

UNIT – IV	**8 Hours**

Introduction: GPUs as Parallel Computers, Architecture of a Model GPU, Why More Speed or Parallelism? Parallel Programming Languages and Models, Overarching Goals. GPU Computing. Introduction to CUDA: Data Parallelism, CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer

Self-study component:	History of GPU Computing: Evolution of Graphics Pipelines

UNIT – V	**8 Hours**

CUDA Threads: CUDA Thread Organization, Using blocked and threaded, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance. CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic, Performance Considerations: More on Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfecting, Instruction Mix, Thread Granularity, Measured Performance and Summary.

Self-study component:	CUDA Programs

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain the technologies and architectures used for parallel computing.	Understanding	L2
CO2	Design and develop parallel programs using OpenMP programming interface.	Create	L6
CO3	Elaborate the principles and architecture of message-passing programming paradigm for solving real world problems.	Analyse	L3
CO4	Provide an understanding of Graphical Processing Units and their architecture.	Understanding	L2
CO5	Analyse the features of GPUs, their functionalities.	Analyse	L3

Text Book(s):

1. Rubin H Landau, Oregon State University, http://science.oregonstate.edu/ robin/
2. Introduction to parallel computing" by Ananth Grama, Anshul Gupta, Vipin Kumar, George Karypis, Pearson education publishers, 2nd Edition
3. Programming Massively Parallel Processors – A Hands-on Approach" by David B Kirk, Wen-Mei W. Hwu,

Reference Book(s):

1. Thomas Rauber and Gudula Ranger, Parallel Programming for Multicore and cluster systems, Springer, International Edition, 2009.
2. Michael J. Quin, Parallel Programming in C with MPI and Open MP, McGraw Hill, 4th Edition.

Machine Learning
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P22AI505**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:
CLO 1. Define machine learning and understand the basic theory underlying machine learning.
CLO 2. Demonstrate the basic concepts of learning.
CLO 3. Explore the basics concept of decision tree and rule based learning.
CLO 4. Illustrate Bayesian techniques and Probabilistic Graphical Models for problems appear in machine learning

UNIT – I	**8 Hours**

Introduction to Machine Learning:
Need for Machine Learning, Machine Learning Explained, Machine Learning in relation to other fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process.

Understanding Data:
Data, Big data analytics and types of analytics, Big data Analysis framework, Descriptive statistics, Univariate data analysis and visualization, Bivariate data and multivariate data, Multivariate statistics, Essential mathematics for multivariate data.

Text book 1: Chapter 1, Chapter 2 (2.1 to 2.8)

Self-study component:	Machine Learning Applications
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Understanding Data:
Overview of Hypothesis, Featured Engineering and Dimensionality Reduction Techniques.

Basics of Learning Theory:
Introduction to Learning and its types, Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning, Induction Biases, Modelling in Machine Learning, Learning Frameworks.

Text book 1: Chapter 2 (2.9 to 2.10), Chapter 3

Self-study component:	Learning Frameworks – Vapnik – Chervonenkis Dimension
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**
Similarity – based Learning: Introduction to similarity or Instance based Learning, Nearest Neighbor Learning, Weighted K – Nearest Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis.** Introduction to Regression, Introduction to Linearity, Correlation and Causation, Introduction to Linear Regression, Validation of Regression Methods, Multiple Linear Regression, Polynomial Regression, Logistic Regression, Reidge and Lasso Regression **Text book 1: Chapter 4 and Chapter 5**	
Self-study component:	Elastic Net Regression
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
UNIT – IV	**8 Hours**
Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Validation and Pruning of Decision Trees. **Rule – based Learning:** Introduction, Sequential Covering Algorithm, First Order Rule Learning, Induction as Inverted Deduction, Inverting Resolution, Analytical Learning or Explanation based Learning, Association Rule Mining **Text book 1: Chapter 6, Chapter 7**	
Self-study component:	Active Learning
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
UNIT – V	**8 Hours**
Bayesian Learning: Introduction to probability based learning, Fundamentals of Bayes Theorem, Classification using Bayes Model, Naïve Bayes Algorithm for continuous attributes. **Probabilistic Graphical Models:** Introduction, Bayesian Belief Network, Markov Chain, Problems solved with HMM **Text book 1: Chapter 8 and Chapter 9**	
Self-study component:	Other popular types of naïve Bayes classifiers
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the basic concept of Machine Learning and data	Understanding	L2
CO2	Apply the basic concept of Learning.	Apply	L3
CO3	Analyse various similarity – based learning and regression algorithms.	Analyse	L4
CO4	Analyse various decision tree and rule based learning	Analyse	L4
CO5	Apply the basics of Bayesian Model and discuss the probabilistic graphical models.	Apply	L3

Text Book(s):

1. S Sridhar and M Vijayalakshmi, Machine Learning, Oxford Higher Education, 2021

Reference Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Machine Learning Laboratory

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P22AIL506**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1. Define machine learning and understand the basic theory underlying machine learning.
CLO 2. Understand the basic concepts of learning and decision trees.
CLO 3. Understand the basics concept of decision tree and rule based learning.
CLO 4. Understand Bayesian techniques and Probabilistic Graphical Models for problems appear in machine learning

1. Descriptive Statistics

The main aim of this experiment is to explore the given dataset. A sample database is created and is available in the file sample.csv. The objectives of this experiment are:

1. Explore all the statistical operations of Pandas and given in Listing 1
2. Use Describe command and explore the dataset as given in Listing 2
3. Use Descriptive Statistics for univariate and bivariate data as given in Listing 3

2. Data Preprocessing

The main aim of this experiment is to preprocess the given dataset. The database is created and is available in the file sample.csv. The objectives of this experiment are

1. Explore Label Encoder
2. Explore Scikit Preprocessing routines like Scaling
3. Explore Scikit Preprocessing routines like Binarizer

3. Graphics Plots

To Explore the Univariate and Bivariate Graphs

4. Data Visualization using Seaborn

To write python program using Seaborn for data visualization. The data visualization is done for both synthetic data as well as for preloaded Iris dataset.

5. Statistical Tests Using SCIPY

To write python program for finding Chi-square test and t-tests using SciPy module

6. Principal Component Analysis

To write python program for finding principal component analysis (PCA) for the given problem and to a randomly generated dataset.

7. Find – S Algorithm

Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file and generate the final specific hypothesis.

8. k-Nearest Neighbor Algorithm

Implement and demonstrate k-Nearest Neighbor algorithm. Read the training data from a .CSV file and build the model to classify a test sample. Print both correct and wrong predictions.

9. Linear Regression

To write Python program for finding linear regression.

10. Logistic Regression

The main aim of this experiment is to explore logistic regression model of scikit-learn. The objectives of this experiment are:

1. Explore random dataset generation for logistic regression.
2. Explore logistic regression model in python for randomly generated dataset

11. Decision Tree Classifier – CART

Implement and demonstrate the working of the decision tree based CART algorithm using a sample data set. Build the decision tree and use this model to classify a test sample.

12. Decision Tree Classifier – ID3

Implement and demonstrate the working of the decision tree based ID3 algorithm using a sample data set. Build the decision tree and use this model to classify a test sample.

13. Naive Bayes Classifier

Implement and demonstrate the working of Naive Bayesian classifier using a sample data set. Build the model to classify a test sample.

14. Hidden Markov Model

Implement and demonstrate Hidden Markov Model (HMM) to decode the hidden states given a sequence of observation states using Viterbi algorithm.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Understand the basic concept of Machine Learning and data	Understanding	L2
CO2	Implement the basic concept of Learning.	Apply	L3
CO3	Implement various similarity – based learning and regression algorithms.	Apply	L3
CO4	Implement various decision tree and rule based learning	Apply	L3
CO5	Implement the basics of Bayesian Model and discuss the probabilistic graphical models.	Apply	L3

Text Book(s):

1. S Sridhar and M Vijayalakshmi, Machine Learning, Oxford Higher Education, 2021

Reference Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Internship - II [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – V**			
Course Code:	**P22INT507**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:0**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to III year of BE shall have to undergo a mandatory internship of 04 weeks during the vacation of IV semesters in industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship/AICTE Intern Shala/College Partnered Industries. A Semester End Examination (Presentation followed by Question Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester grade card. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

Internship-II: SEE component will be the only seminar/Presentation and question answer session

EMPLOYABILITY ENHANCEMENT SKILLS - V
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V for CSE, ISE, ECE, EEE & CSE(AIML) Branches only

Course Code:	**P22HSMC508B**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Calculations involving Time and work, Speed & distance, trains, boats and streams and races.
- Explain concepts behind logical reasoning modules of clocks and calendars.
- Develop problem solving skills through Data structures.

UNIT – I		**06 Hours**

Quantitative Aptitude: Time and Work, Time, Speed and Distance.

Logical Reasoning: Clocks and Calendars.

Self-study component:	Decimal fractions

UNIT – II		**06 Hours**

Quantitative Aptitude: Trains, Boats and Streams, Races.

Verbal Ability: Reading Comprehension, Critical Reasoning.

Self-study component:	Game based assessments

UNIT – III	**ADVANCED DATA STRUCTURES - I**	**06 Hours**

Priority Queues: Introduction to Priority Queues, Ways to implement priority queues, Introduction to heaps, Introduction to Complete Binary Trees and its implementation, Insert and Delete operations in heaps, Implementing priority queues, Heap sort, Inbuilt Priority Queue

Hashmaps: Introduction to Hashmaps, Inbuilt Hashmap, Hash functions, Collision handling, Insert and Delete operation implementation in hashmap, Load factor, Rehashing

Self-study component:	Applications of Queues: Josephus Problem

UNIT – IV	**ADVANCED DATA STRUCTURES - II**	**06 Hours**

Tries: Introduction to Tries, making a Trie Node class, Insert, Search and Remove operation implementation in Tries, Types of Tries, Huffman coding.

Graphs: Introduction to Graphs, Graph Terminology, Graph implementation, Graph Traversals (DFS and BFS), Weighted and Directed Graphs, Minimum Spanning Trees, Cycle Detection in Graphs, Kruskal's algorithm, Prim's algorithm, Dijkstra's algorithm.

Self-study component:	Optimal Binary Search Trees.

UNIT – V	ADVANCED DATA STRUCTURES - III	06 Hours

Introduction to Dynamic Programming: Introduction to Memoization, Introduction to Dynamic Programming, Fibonacci numbers using recursion, memoization and dynamic programming

Applications of Dynamic Programming: Longest Common Subsequence (LCS) using recursion, memorization and dynamic programming, Edit distance using recursion, memorization and dynamic programming, Knapsack problem using recursion, memorization and dynamic programming

Self-study component:	Lower Bound Arguments, Decision trees.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on Time and work, Speed & distance, trains, boats and streams and races.	Applying	L3
CO2	Solve logical reasoning problems based on Clocks and calendars and verbal ability skills of reading comprehension and critical reasoning.	Applying	L3
CO3	Analyze and represent various data structures and its operations.	Analyzing	L4
CO4	Develop programs with suitable data structure based on the requirements of the real-time applications	Applying	L3

Text Book(s):

1. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
2. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava
3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Aaron M Tenenbaum, Yedidyah Langsam and Moshe J Augenstein, "Data Structures using C", 2014, low price edition ,Pearson education.
2. Seymour Lipschutz, Data Structures with C (Schaum's Outline Series) , July 2017, McGraw Hill Education.
3. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/
2. https://www.youtube.com/watch?v=CBYHwZcbD-s
3. https://www.youtube.com/watch?v=2ZLl8GAk1X4
4. https://www.youtube.com/watch?v=MdG0Vw9f1A4

COURSE ARTICULATION MATRIX **(EMPLOYABILITY ENHANCEMENT SKILLS - V – P22HSMC508B)**												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2										
CO4	1	1	2									1

Social Connect and Responsibility

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P22UHV509**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**25+5**	**SEE Marks:**	**--**

Course Outcomes: This course will enable the students to:

- **Identify** the needs of the community and involve them in problem solving.
- **Demonstrate** the knowledge about the culture and societal realities.
- **Develop** sense of responsibilities and bond with the local community.
- **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.
- **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.

PART-I	

Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excpert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.

PART-II	

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.

PART-III	

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

PART-IV	

Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

PART-V	

Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** the needs of the community and involve them in problem **solving.**	**Knowledge / Apply**	**L1 & L3**
CO2	**Demonstrate** the knowledge about the culture and societal realities.	**Understand**	**L2**
CO3	**Develop** sense of responsibilities and bond with the local community	**Apply**	**L4**
CO4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	**Apply**	**L4**
CO5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.	**Create**	**L6**

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	**Course Outcome**	**Programme Outcomes**												**Programme Specific outcomes**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**Identify** the needs of the community and involve them in problem **solving.**	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
2	**Demonstrate** the knowledge about the culture and societal realities.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
3	**Develop** sense of responsibilities and bond with the local community.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) :

After completion of the social connect and responsibility course, the student shall prepare, with daily diary/ report as reference and a comprehensive report in consultation with the faculty/mentor to indicate what he has observed and learned in the social connect period.

The report shall be evaluated on the basis of the following below criteria's or other relevant criteria pertaining to the activity completed.

- Planning and scheduling the social connect.
- Information/Data collected during the social connect.
- Analysis of the information/data and report writing.
- Presentation and interaction.

CIE Rubrics for Evaluation.

Report	Video presentation	Interaction	Total
10	05	05	20

Note:

- Video presentation of **4 to 5 min** in a team to be presented and the same to be uploaded in the department YouTube channel.
- The number of students in each team can be from **4 to 5** members.
- Each activities has to be evaluated on above basis that is [20 * 5 = 100 marks] for final total marks.

Duration : A total of 25 – 30 hours engagement per semester is required for the 5th semester of the B.E./B.Tech. program. The students will be divided into groups and each group will be handled by faculty mentor.

Pedagogy – Guidelines:

Special Note: NO SEE – Semester End Exam – Completely Practical and activities based evaluation

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	**Group size**	Location	**Activity execution**	**Reporting**	**Evaluation Of the Topic**
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Natural Language Processing

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P22AI601**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2:1:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the basic concepts and basic algorithms of Natural language processing.
CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers
CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.
CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

UNIT – I	**8 Hours**
Overview and language modeling: Overview: Origins and challenges of NLP- Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models	
Self-study component:	Statistical Language Model.

UNIT – II	**8 Hours**
Word level and syntactic analysis: Word Level Analysis: Regular Expressions- Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words. Word classes-Part-of Speech Tagging: Part-of- Speech Tagging, Rule-based Part-of-speech Transformation-Based Tagging; Tagging.	
Self-study component:	Stochastic Part-of-speech Tagging,

UNIT – III	**8 Hours**
N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; Context Free Grammars for English: Constituency, grammatical relations, Context Free Grammar.	
Self-study component:	Syntactic Parsing: Parsing as Search.

UNIT – IV	**8 Hours**
Discourse: Cohesion, Reference Resolution; Generation: Introduction to Language Generation, An Architecture for Generation; Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages.	
Self-study component:	Corpus based Machine Translation.

UNIT – V	**8 Hours**
Information Retrieval and Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – Evaluation Lexical Resources: World Net-Frame Net- Stemmers	
Self-study component:	POS Tagger- Research Corpora

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the importance of natural language applications and its need.	Understand	L2
CO2	Analyze the natural language text and parse the grammar.	Analyze	L3
CO3	Apply information retrieval techniques and machine translation on Indian languages.	Apply	L4
CO4	Illustrate the way N-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories.	Apply	L4
CO5	Emphasize problems that NLP systems face, natural language outputs construction from non-linguistic inputs and machine translation framework approaches.	Apply	L4

Textbook:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

Reference book(s):

1. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

Full Stack Development
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AI6021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1. Explain the use of learning full stack web development.
CLO 2. Make use of rapid application development in the design of responsive web pages.
CLO 3. Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.
CLO 4. Demonstrate the use of state management and admin interfaces automation in Django.
CLO 5. Design and implement Django apps containing dynamic pages with SQL databases.

UNIT – I **8 Hours**

MVC based Web Designing
Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django

Textbook 1: Chapter 1 and Chapter 3

Self-study component: Wild Card patterns in URLS.

UNIT – II **8 Hours**

Django Templates and Models
Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.

Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects.

Textbook 1: Chapter 4 and Chapter 5

Self-study component: Schema Evolution

UNIT – III **8 Hours**

Django Admin Interfaces and Model Forms
Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.

Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms,

Textbook 1: Chapters 6, 7 and 8

Self-study component: URLConf Ticks, Including Other URLConfs.

UNIT – IV	**8 Hours**
Generic Views and Django State Persistence Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views. MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions. Textbook 1: Chapters 9, 11 and 12	
Self-study component:	Users and Authentication.
UNIT – V	**8 Hours**
jQuery and AJAX Integration in Django Ajax Solution, Java Script, XHTML HttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities. Textbook 2: Chapters 1, 2 and 7.	
Self-study component:	Using jQuery UI Autocomplete in Django

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the working of MVT based full stack web development with Django.	Understand	L2
CO2	Designing of Models and Forms for rapid development of web pages.	Create	L6
CO3	Analyze the role of Template Inheritance and Generic views for developing full stack web applications.	Analyze	L3
CO4	Apply the Django framework libraries to render non HTML contents like CSV and PDF.	Apply	L4
CO5	Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,	Create	L6

Textbook:

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009
2. Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, First Edition, Pack Publishing, 2011

Reference book(s):

3. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
4. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
5. Antonio Mele, Django3 by Example, 3rd Edition, Pack Publishers, 2020
6. Arun Ravindran, Django Design Patterns and Best Practices, 2nd Edition, Pack Publishers, 2020. 03.09.2022
7. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1st Edition, Oreily Publications, 2014

Web and Video link(s):

1. MVT architecture with Django: https://freevideolectures.com/course/3700/django-tutorials
2. Using Python in Django: https://www.youtube.com/watch?v=2BqoLiMT3Ao
3. Model Forms with Django: https://www.youtube.com/watch?v=gMM1rtTwKxE
4. Real time Interactions in Django: https://www.youtube.com/watch?v=3gHmfoeZ45k
5. AJAX with Django for beginners: https://www.youtube.com/watch?v=3VaKNyjlxAU

Cloud Computing [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P22AI6022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

The student will be able to:
CLO 1. Identify the architecture, infrastructure and delivery models of cloud computing
CLO 2. Compare and contrast different cloud services.
CLO 3. Apply suitable virtualization concept.
CLO 4. Apply Cloud automation and management tools to build your own cloud application in Google Cloud Platform.

UNIT – I	Introduction to Cloud Infrastructure	**8 Hours**

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major Challenges Faced by Cloud Computing, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing.

Self-study component:	Comparative analysis on Services provided by AWS AND GCP

UNIT – II	**Cloud Computing: Application Paradigms and Concepts**	**8 Hours**

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Grep The Web application. Cloud Resource Virtualization-Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and Para virtualization, Hardware support for virtualization.

Self-study component:	Virtualization in AWS and Microsoft Azure

UNIT – III	**Resource Management and Scheduling**	**8 Hours**

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling.

Self-study component:	Application of map reduce in AWS and Microsoft Azure

UNIT – IV	Google Cloud Platform and Services	8 Hours
Types of Cloud Services, Cloud Computing vs. Data Center Computing. Computing Components of Google Cloud Platform, Storage Components of Google Cloud Platform, Networking Components of Google Cloud Platform, Additional Components of Google Cloud Platform. How GCP Organizes Projects and Accounts, Roles and Identities, Billing, Enabling APIs.		
Self-study component:	Projects and Accounts, Roles and Identities, Billing, Enabling APIs in AWS and Microsoft Azure	
UNIT – V	**Computation in Google Cloud**	**8 Hours**
Compute Engine, App Engine, Kubernetes Engine, Cloud Functions, Creating and Configuring Virtual Machines with the console, Creating and Configuring Virtual Machines with Cloud SDK, Basic Virtual Machine Management, Guidelines for planning, Deploying and Managing Virtual Machines, Managing Single Virtual Machine Instances, Introduction to Instance Groups, Guidelines for Managing Virtual Machine.		
Self-study component:	Execution of Kubernetes Engine in AWS and Microsoft Azure	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the basic cloud computing concepts and distinguish between the various cloud infrastructures.	Understanding	L2
CO2	**Explain** application paradigm and concept	Understanding	L2
CO3	**Apply** different types of virtualization and Resource Management techniques that can be used in designing cloud applications.	Applying	L3
CO4	**Explain** google platform and services.	Understanding	L2
CO5	**Apply** Google Cloud Platform using Qwiklabs to build cloud applications.	Applying	L3

Text Book(s):

1. Dan C Marinescu: Cloud Computing Theory and Practice, 2nd edition. Elsevier (MK) 2013.
2. Dan Sullivan: Official Google Cloud Certified Associate Cloud Engineer Study Guide, 1st edition, SYBEX, 2019

Reference Book(s):

1. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

Web and Video link(s):

5. AWS https://www.youtube.com/watch?v=k1RI5locZE4
6. GCP https://www.youtube.com/watch?v=m6ozQnqit50
7. Aneka https://www.youtube.com/watch?v=8FeysgQLwIo

Business Intelligence and its Application

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P22AI6023**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Comprehend the need of BI for a business enterprise.
2. Summarize the types of Digital data & its operation.
3. To outline the Need & Significance of data warehouse in BI applications.
4. Identify the types and step involved in ETL process.
5. To understand the measurement concept to evaluate business performance and build enterprise reports

UNIT – I **8 Hours**

Business View of Information Technology Applications:
Business Enterprise Organization, Its Functions, and Core Business Processes; Baldrige Business Excellence Framework; Key Purpose of Using IT in Business; The Connected World: Characteristics of Internet-ready IT Applications; Enterprise Applications (ERP/CRM, etc.) and Bespoke IT Applications; Information Users and Their Requirements; Case Studies.

Types of Digital Data:
Introduction; Getting into "GoodLife" Database; Getting to Know Structured Data; Getting to Know Unstructured Data; Getting to Know Semi-Structured Data.

Self-study component: Difference Between Semi-Structured and Structured Data

UNIT – II **8 Hours**

Introduction to OLTP and OLAP:
OLTP (On-Line Transaction Processing); OLAP (On-Line Analytical Processing); Different OLAP Architectures; OLTP and OLAP; Data Models for OLTP and OLAP; Role of OLAP Tools in the BI Architecture; Should OLAP be Performed Directly on Operational Databases? A Peek into the OLAP Operations on Multidimensional Data.

Getting Started with Business Intelligence:
Using Analytical Information for Decision Support; Information Sources Before Dawn of BI? Business Intelligence (BI) Defined; Evolution of BI and Role of DSS, EIS, MIS, and Digital Dashboards; Need for BI at Virtually all Levels; BI for Past, Present, and Future; The BI Value Chain; Introduction to Business Analytics

Self-study component: Leveraging ERP Data Using Analytics

UNIT – III **8 Hours**

BI Definitions and Concepts:
BI Component Framework; Who is BI for? BI Users; Business Intelligence Applications; BI Roles and Responsibilities; Best Practices in BI/DW; The Complete BI Professional.

Basics of Data Integration:
Need for Data Warehouse; Definition of Data Warehouse; What is a Data Mart? What is Then an ODS? Ralph Kimball's Approach vs. W.H. Inmon's Approach; Goals of a Data Warehouse; What Constitutes a Data Warehouse? Extract, Transform, Load; What is Data Integration? Data Integration Technologies; Data Quality; Data Profiling

Self-study component: Popular BI Tools.

UNIT – IV	**8 Hours**
Multidimensional Data Modeling: Introduction; Data Modeling Basics; Types of Data Model; Data Modeling Techniques; Fact Table; Dimension Table; Typical Dimensional Models; Dimensional Modeling Life Cycle. **Measures, Metrics, KPIs, and Performance Management:** Understanding Measures and Performance; Measurement System Terminology; Navigating a Business Enterprise, Role of Metrics, and Metrics Supply Chain; "Fact-based Decision Making" and KPIs; KPI Usage in Companies; Where Do Business Metrics and KPIs Come From?	
Self-study component:	Connecting the Dots: Measures to Business Decisions and Beyond
UNIT – V	**8 Hours**
Basics of Enterprise Reporting: Reporting Perspectives Common to All Levels of Enterprise; Report Standardization and Presentation Practices; Enterprise Reporting Characteristics in OLAP World; Balanced Scorecard; Dashboards; How Do You Create Dashboards? Scorecards vs. Dashboards **Bi Road Ahead:** Understanding BI and Mobility; BI and Cloud Computing; Business Intelligence for ERP Systems; Social CRM and BI.	
Self-study component:	The Buzz Behind Analysis.

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Interpret the business view of information technology applications	Analyze	L3
CO2	Summarize the types of Digital data & its operation.	Analyze	L3
CO3	Outline the Need & Significance of data warehouse in BI applications	Understand	L2
CO4	Explain the basics of data integration including data quality and data profiling and implement various data integration approaches	Apply	L4
CO5	Identify Key Performance Indicators, Business Metrics, Future of BI, creation of Enterprise Reports.	Analyze	L3

Textbook:

1. Prasad RN, Seema Acharya: Fundamentals of Business Analytics, Second Edition, Wiley India Pvt. Ltd.

Reference book(s):

8. William H. Inmon: Building the Data Warehouse, 4th Edition, Wiley India Ed.
9. David Loshin: Business Intelligence, First Edition, Elsevier Science, 2003.

Computer Vision

[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AI6024**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Summarize basic concepts, terminology, theories, models and methods in the field of computer vision.
- Familiarize with the principles of Segmentation, Motion Segmentation and Classification
- Implement appropriate object Tracking and detection methods for computer vision applications

UNIT – I	**8 Hours**

Image Formation and Filtering

Geometric Camera Models - Pinhole perspective, Intrinsic and Extrinsic Parameters, Geometric Camera Calibration. Linear Filters- Linear Filters and Convolution, Shift Invariant Linear Systems. Filters as Templates - Normalized Correlation and Finding Patterns.

Self-study component:	

UNIT – II	**8 Hours**

Local Image Features and Stereo Vision

Image Gradients - Computing the Image Gradient, Gradient Based Edge and Corner Detection. Stereopsis- Binocular Camera Geometry, Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion.

Self-study component:	

UNIT – III	**8 Hours**

Segmentation

Segmentation - Background subtraction, Interactive segmentation, Forming image regions. Segmentation by clustering - Watershed Algorithm. Motion Segmentation by Parameter Estimation- Optical Flow and Motion, Flow Models, Motion Segmentation with Layers.

Self-study component:	

UNIT – IV	**8 Hours**

Classification and Tracking

Classification - Classification Basics, Two-class and Multiclass classifiers, Error, Overfitting and Regularization, Cross Validation, Classifying Images of Single Objects. Tracking - Tracking Basics, Simple Tracking Strategies, tracking by detection, Tracking Linear Dynamical models with Kalman filters.

Self-study component:	

UNIT – V	**8 Hours**

Finding Objects and other Applications

Object detection - The Sliding Window Method. Object Recognition -Goals of Object Recognition System. Applications - Robot Navigation by stereo vision, Face detection, Face recognition, Activity Recognition, Tracking people.

Self-study component:	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand basic concepts, terminology, theories, models and methods in the field of computer vision.	**Understand**	**L2**
CO2	Explain basic methods of computer vision related to multi-scale representation, edge detection, detection of other primitives, stereo, motion and object recognition.	**Understand**	**L2**
CO3	Describe principles of Segmentation, Motion Segmentation and Classification	**Understand**	**L2**
CO4	Analyze appropriate object Tracking and detection methods for computer vision applications	**Analyse**	**L4**
CO5	Implement a computer vision system for a specific problem	**Apply**	**L3**

Text Book(s):

1. Forsyth, David, and Jean Ponce. Computer vision: A modern approach. Prentice hall, 2011.

Reference Book(s):

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, Springer, 2022.

Fundamentals of DevOp's
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AI6031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- The objective of the course is to acquaint students with the principles and philosophies of DevOps and to explain the foundational material for DevOps.
- It also introduces students to basic DevOps tools used in the industry for DevOps Engineering.
- Students will have a hands-on experience of building a CI/CD pipeline for continuous Integration, continuous delivery from start to finish.
- It also introduces students to Docker and its details.
- It also introduces students to Kubernetes and its details.

UNIT – I **8 Hours**

DevOps Culture and Practices,Getting started with DevOps,Implementing CI/CD and continuous deployment, Continuous integration(CI), Implementing CI,Continuous delivery(CD),Continuous deployment,Understanding IaC practices,The benefits of IaC, IaC languages and tools,Scripting types, Declarative types,The IaC topology, The deployment and provisioning of the infrastructure, Server configuration, Immutable infrastructure with containers, Configuration and deployment in Kubernetes, IaC best practices

Optimizing Infrastructure Deployment with Packer:

Technical requirements,An overview of Packer, Installing Packer,Installing manually, Installing by script, Installing Packer by script on Linux, Installing Packer by script on Windows, Integrating Packer with Azure Cloud Shell, Checking the Packer installation, Creating Packer templates for Azure VMs with scripts,The structure of the Packer template, The builders section, The provisioners section, The variables section,Building an Azure image with the Packer template,Using Ansible in a Packer template,Writing the Ansible playbook,Integrating an Ansible playbook in a Packer template,Executing Packer,Configuring Packer to authenticate to Azure,Checking the validity of the Packer template,Running Packer to generate our VM image

Self-study component:	Practically implement the above concepts

UNIT – II **8 Hours**

DevOps CI/CD Pipeline I : Managing Your Source Code with Git,Technical requirements, Overviewing Git and its command lines, Git installation, Configuration Git, Git vocabulary, Git command lines, Retrieving a remote repository, Initializing a local repository, Configuring a local repository, Adding a file for the next commit, Creating a commit, Updating the remote repository, Synchronizing the local repository from the remote, Managing branches, Understanding the Git process and GitFlow pattern,Starting with the Git process,Creating and configuring a Git repository, Committing the code, Archiving on the remote repository, Cloning the repository, The code update, Retrieving updates,Isolating your code with branches, Branching strategy with GitFlow, The GitFlow pattern, GitFlow tools.

Self-study component:	Practically implement the above concepts

UNIT – III	8 Hours
DevOps CI/CD Pipeline II: Continuous Integration and Continuous Delivery, Technical requirements, The CI/CD principles, Continuous integration(CI) ,Continuous delivery(CD),Using a package manager,Private NuGet and npm repository, Nexus Repository OSS,Azure Artifacts,Using Jenkins,Installing and configuring Jenkins, Configuring a GitHub webhook, Configuring a Jenkins CI job,Executing the Jenkins job,Using Azure Pipelines, Versioning of the code with Git in Azure Repos,Creating the CI pipeline,Creating the CD pipeline :the release, Using GitLab CI, Authentication at GitLab, Creating a new project and managing your code source, Creating the CI pipeline,Accessing the CI pipeline execution details.	
Self-study component:	Practically implement the above concepts
UNIT – IV	**8 Hours**
Containerized Applications with Docker: Containerizing Your Application with Docker, Technical requirements, Installing Docker, Registering on Docker Hub, Docker installation, An overview of Docker's elements, Creating a Dockerfile , Writing a Dockerfile, Dockerfile instructions overview, Building and running a container on a local machine,Building a Docker image,Instantiating a new container of an image, Testing a container locally, Pushing an image to Docker Hub, Deploying a container to ACI with a CI/CD pipeline, The Terraform code for ACI, Creating a CI/CD pipeline for the container.	
Self-study component:	Practically implement the above concepts
UNIT – V	**8 Hours**
Containerized Applications with Kubernetes : Managing Containers Effectively with Kubernetes, Technical requirements, Installing Kubernetes, Kubernetes architecture overview, Installing Kubernetes on a local machine, Installing the Kubernetes dashboard, First example of Kubernetes application deployment, Using HELM as a package manager, Using Azure Kubernetes service, Configuring kubectl for Azure Kubernetes services Advantages of Azure Kubernetes Service, Creating a CI/CD pipeline for Kuberrnetes with Azure Pipelines, The build and push of the image in the Decker Hub , Automatic deployment of the application in Kubermetes	
Self-study component:	Practically implement the above concepts

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Apply** various **Concepts** and **Principles** used in the topics to understand the theory related to DevOps.	Remember	L1
CO2	**Discuss** the fundamental **Definitions** of DevOps & Github relevant to Software development and deployment.	Understanding	L2
CO3	**Assess** the CI/CD **problems** by applying proper solutions to verify the theoretical concepts.	Understanding	L2
CO4	**Understand** the various **Properties** and **Applications** pertaining **to Dockers.**	Applying	L3
CO5	**Understand** the various **Properties** and **Applications** pertaining to Kubernetes.	Applying	L3

Text Book(s):

1. Mikel Krief: Learning DevOps, Published by Packt Publishing Ltd, October 2019.
2. Mitesh Soni: DevOps Bootcamp, Published by Packt Publishing Ltd, May 2017.

Reference Book(s):

1. Michael Duffy: DevOps Automation Cookbook, Published by Packt Publishing Ltd, Nov 2015.
2. Jennifer Davis: Effective DevOps, Published by O'Reilly Media,in. June 2016
3. David Gonzalez: implementing Modern DevOps, Published by Packt Publishing Ltd,Oct 2017

Web and Video link(s):

1. https://learn.microsoft.com/en-us/azure/devops
2. https://www.guvi.in/devops
3. https://www.youtube.com/watch?v=hQcFE0RD0cQ

E-Books/Resources:

1. https://www.edureka.co/blog/ebook/devops-ebook
2. https://www.dynatrace.com/resources/ebooks/devops

IoT Communication Protocols

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P22AI6032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand fundamentals of IoT architecture outline and standards.
- Understand and analyse different architectural views.
- Understand the importance of IoT Layer Protocols.
- Understand the importance of architecture and Industrial Internet of Things.

UNIT – I	**8 Hours**

Fundamentals of IoT Introduction

IoT Technology trends and future opportunities, IoT and Business scope Evolution, Business perspectives, Embedded systems Relationships, Challenges of IoT, Characteristics of IoT, Sensors and Actuators in IoT enabling Industrial Automation, Wireless sensor Networks in IoT, connecting all the things in Internet of things, IoT M2M, Software Define Networking.

Textbook: Ch1, 1.1-1.13

Self-study component:	IoT System Management is Essential.

UNIT – II	**8 Hours**

IoT protocols

Introduction IOT life cycle , Physical Design, IOT Conceptual architecture, IOT protocols, Levels of IOT, IOT networking Protocols

Textbook: Ch.3 3.1-3.8

Self-study component:	Networking standards and technologies in IOT

UNIT – III	**8 Hours**

IoT protocols

Introduction of 5G networks in IoT, IoT Networking consideration and Challenges, Business case for the IoT, Network optimization for IoT devices, Transport Layer protocols, Network Layer Protocols, IoT communication Challenges.

Textbook: Ch.3, 3.9-3.17.

Self-study component:	Application Protocols for IoT.

UNIT – IV	**8 Hours**

IIOT

Introduction, Evolution of IIOT, Advantages of IIOT, Drivers, Risk associated with IIOT, Businesses and Industries approach IIOT security, Applications of IIOT, Work flow of IIOT, Security considerations and challenges

Textbook: ch.4, 4.1-4.11

Self-study component:	IIOT : Use Cases

UNIT – V	**8 Hours**

Architecture of IIOT

Introduction, IIOT layered Architecture, three tier IIOT, Security in IIOT, Service based Frameworks, Solutions against Intrusions in IIOT, Machine learning based solutions.

Textbook: Ch.5, 5.1-5.9

Self-study component:	Deep Learning based solutions

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand fundamentals of IoT and Architecture.	Understand	L2
CO2	Illustrate the different layers of IoT protocols.	Understand	L2
CO3	Explore the importance of Industrial IoT.	Analyse	L4
CO4	Demonstrate Use cases of IIoT applications.	Create	L6

Text Book(s):

1. Dr. Vijendra Pratap Singh, Mr. Neeraj Kumar, "IoT Communication Protocols", ISBN: 978 81-961690-9-1, Deccan International Academic Publishers,2023.

Reference Book(s):

1. Bernd Scholz-Reiter, Florian Micha Helles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

Robotics Process Automation – Design and Development
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AI6033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Understand the basic concepts of RPA platform.
2. Describe the different types of variables, control flow and data manipulation techniques.
3. Understand various control techniques, plugins and extensions in RPA.
4. Describe various types and strategies to handle events and exceptions.

UNIT – I	**8 Hours**
Robotic Process Automation: Introduction, Scope and techniques of automation Robotic process automation, About UiPath, The future of automation. Record and Play: Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder.	
Self-study component:	Step-by-step examples using the recorder.

UNIT – II	**8 Hours**
Sequence, Flowchart, and Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart. Data Manipulation: Data Manipulation, Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example.	
Self-study component:	Step-by-step example, using Sequence and Control flow.

UNIT – III	**8 Hours**
Taking Control of the Controls: Taking Control of the Controls, Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with Ui Explorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, Avoiding typical failure points.	
Self-study component:	How to use OCR

UNIT – IV	**8 Hours**
Tame that Application with Plugins and Extensions: Tame that Application with Plugins and Extensions, Terminal plugin, SAP automation, Java plugin, Citrix automation, Mail plugin, PDF plugin, Excel and Word plugins. Handling User Events and Assistant Bots: Handling User Events and Assistant Bots, What are assistant bots? Monitoring system event triggers, monitoring image and element triggers, Launching an assistant bot on a keyboard event.	
Self-study component:	Credential management

UNIT – V	**8 Hours**
Exception Handling, Debugging, and Logging: Exception Handling, Debugging, and Logging, Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps.	
Self-study component:	Error reporting.

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Demonstrate Robotic Process Automation & Record and Play feature of UiPath Studio.	Understand	L2
CO2	Create different types of variables, control flow and data manipulation techniques.	Apply	L3
CO3	Apply various control techniques, plugins and extensions in RPA.	Apply	L3
CO4	Illustrate various types and strategies to handle events and exceptions.	Understand	L2

Textbook:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Pack pub, March 2018.

Reference book(s):

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren
2. Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software
4. Robots, Automate Repetitive Tasks & Become an RPA Consultant.
5. Srikanth Merinda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

Web and Video link(s):

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

Augmented Reality and Virtual Reality [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P22AI6034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the importance of Augmented reality and Virtual reality
CLO2: Describe the history and recent developments of AR
CLO3: Provide the need on emerging technologies AR and VR
CLO4: Discuss the revolution and impact of AR
CLO5: Understand the applications of AR and VR

UNIT – I	**8 Hours**

Introduction: Definition of VR, modern experiences, historical perspective. Virtual Reality Applications.

Birds-eye view: Hardware, Software, Human physiology and Perception

Self-study component:	Aural: world-fixed vs. user-fixed, Developer choices for VWGs

UNIT – II	**8 Hours**

Geometry of Virtual Worlds: Geometric models, Changing Position and orientation, Axis-Angle representation of rotation, Chaining the transformation.

Tracking: Tracking 2D orientation, Tracking 3D orientation, Tracking Position and orientation.

Self-study component:	Viewing Transformation, The Physiology of Human Vision, Tracking Attached Bodies, 3D Scanning of Environments.

UNIT – III	**8 Hours**

Getting started with Blender: An introduction to Blender. Features of Blender Layout workspace, Sculpt Workspace, Modelling Workspace, Animation Workspace.

Introduction to Unity, working with objects, Working with Scripts First Person Controller, Third Person Controller.

Self-study component:	Advanced concepts in Blender and Unity tools.

UNIT – IV	**8 Hours**

Introduction to Augmented Reality: Definition and scope, A brief history of augmented reality, Examples, Related fields.

Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display model, Visual Displays.

Self-study component:	Ubiquitous computing, Ergonomics, Social Acceptance

UNIT – V			**8 Hours**
Evaluating VR Systems and Experiences: Perceptual Training, Recommendations for developers,Comfort and VR sickness, Experiments on Human subjects. **Software Architectures:** AR Application Requirements, Software Engineering Requirements.			
Self-study component:	Peripheral problems, Sickness reduction strategies		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain the fundamental concepts of Virtual Reality and Augmented Reality and it's Applications.	Understand	**L1**
CO2	Analyse the hardware and software requirements of Augmented Reality and Virtual reality.	Analyse	**L2**
CO3	Apply Geometric Modelling Techniques for 2D and 3D model creation in AR/VR.	Apply	**L3**
CO4	**Design** a Virtual Environment to captivate its experiences using Blender and Unity tools.	**Design**	**L4**

Text Book(s):

1. Steven M. LaValle: Virtual Reality, 2019. **Cambridge university press.**
2. Dieter Schmalstieg and Tobias Höllerer: Augmented Reality Principles and Practice, Addison-Wesley, 2016, **Pearson Education**

Reference Book(s):

1. Kaliraj P, Devi T, (2021). Innovating with Augmented Reality: Applications in Education and Industry (P. Kaliraj, Ed.) (1st ed.). Auerbach Publications. https://doi.org/10.1201/9781003175896
2. Virtual Reality & Augmented Reality in Industry by Dengzhe Ma, Jürgen Gausemeier, Xiumin Fan, Michael Grafe By: Springer publications.
3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

Web and Video link(s):

1. https://docs.google.com/presentation/d/1ghccIoncBT34OargDKABa_he2Yjy1S-P/edit?usp=sharing&ouid=105825739444009503878&rtpof=true&sd=true
2. https://drive.google.com/file/d/1Qbt7bwPmPXkQq52wOacCZ5BcBMqLUksY/view?usp=sharing
3. https://drive.google.com/file/d/1p-0Oje6zXoefCwbkxUOk49MxyVbLhYd3/view?usp=sharing
4. https://drive.google.com/file/d/1H0MSJdPfOGxDaDX6mzw8WxvM6C5GZ5Wj/view?usp=drive_link
5. https://drive.google.com/file/d/1eG3Yv-XEwEGH7-G8HTE9DOIg_hKuOSbb/view?usp=sharing

CO-PO Mapping

CO's	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	Explain the fundamental concepts of Virtual Reality and Augmented Reality and it's Applications.	**1**											
CO2	Analyse the hardware and software requirements of Augmented Reality and Virtual reality.	**1**	**1**			1							
CO3	Apply Geometric Modelling Techniques for 2D and 3D model creation in AR/VR.	**1**	**1**	**2**		1							
CO4	Design a Virtual Environment to captivate its experiences using Blender and Unity tools.	**2**	**2**	**2**		2							2

Advanced Machine Learning
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AI604**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40 + 20 Hrs**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:
CLO 1. Understand the basic concept of Artificial Neural Networks.
CLO 2. Explore the concepts of Support Vector Machines and Ensemble Learning.
CLO 3. Illustrate the concept of Clustering Analysis and Reinforcement Learning.
CLO 4. Demonstrate with examples the concept of Genetic Algorithm.
CLO 5. Explore the concept of Deep Learning.

UNIT – I	**8 Hours**

Artificial Neural Networks:
Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Learning in a Multi-layer Perceptron, Radial Basis Functional Neural Network, Self-organized Feature Map, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of Artificial Neural Networks.

Textbook 1: Chapter 10

Self-study component:	Challenges of Artificial Neural Networks
Practical Component:	**Implement a perceptron model in Python** **Implement a Multi-Layer Perceptron (MLP) model with back propagation to solve the XOR Boolean function in Python**
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Support Vector Machines:
Introduction to Support Vector Machines, Optimal Hyperplane, Functional and Geometric Margin, Hard Margin SVM as a Optimization Problem, Soft Margin Support Vector Machines, Introduction to kernels and non-linear SVM, Kernal-based Non-Linear Classifier, Support Vector Regression.

Ensemble Learning:
Introduction, Parallel Ensemble Models, Sequential Ensemble Models

Textbook 1: Chapter 11 and Chapter 12

Self-study component:	Incremental Ensemble Models
Practical Component:	**Implement a Support vector machine for the Iris dataset in Python** **Implement a Support Vector Regression in Python**

	Implement a Random Forest classifier and Random Forest regressor in Python **Implement a AdaBoost algorithm in Python**
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**

Clustering Algorithms:
Introduction to Clustering approaches, Proximity measure, Hierarchical Clustering Algorithms, Partial Clustering Algorithm, Density based methods, Grid-based approach, Probability Model – based Methods, Cluster Evaluation Methods

Reinforcement Learning:
Overview of Reinforcement Learning, Scope of Reinforcement Learning, Reinforcement Learning as Machine Learning, components of Reinforcement Learning, Markov Decision Process, Multi-arm Bandit Problem and Reinforcement problem types, Machine based Learning, Model Free Methods, SARSA Learning.

Text book 1: Chapter 13 and Chapter 14

Self-study component:	Q-Learning,
Practical Component:	**Implement a hierarchical clustering algorithm in Python** **Implement a k-Means Algorithm in Python**
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	**8 Hours**

Genetic Algorithms:
Overview of Genetic Algorithms, Optimization Problems and Search Spaces, Genetic Structure of a Genetic Algorithm, Genetic Algorithm Components, Case Studies in Genetic Algorithms – Maximization of a Function, Evolutionary Computing.

Text book 1: Chapter 15

Self-study component:	Case Studies in Genetic Algorithms – Genetic Algorithm Classifier
Practical Component:	**Implement a Genetic Algorithm (GA) in Python** **Implement a Genetic Algorithm (GA) in Python to maximize a simple mathematical function**
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	**8 Hours**

Deep Learning:
Introduction to Deep Neural Networks, Introduction to Loss function and Optimization, Regularization Methods, Convolution Neural Networks, Transfer Learning, Recurrent Neural Networks, LSTM and GRU

Text book 1: Chapter 16

Self-study component:	Applications of Deep Learning
Practical Component:	**A Simple Deep Neural Network using Kera's -** The main aim of this experiment is to explore Kera's for building a small neural network. The aim of this experiment is only to understand how Kera's works. **Implement a Convolutional Neural Network (CNN) in Python using TensorFlow/Kera's** **Implementing a Simple RNN in Python using TensorFlow/Kera's**
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Evaluate various types of artificial neural networks from the basic principles to practical applications.	Evaluate	L5
CO2	Apply and analyse Support Vector Machines and Ensemble Learning techniques, from theory to practical use, covering optimization, non-linear classification with kernels, and diverse parallel and sequential ensemble models	Apply	L3
CO3	Analyse clustering algorithms for diverse effectiveness evaluation and explore reinforcement learning fundamentals from Markov Decision Processes to model-free techniques	Analyse	L4
CO4	Analyse Genetic Algorithms, covering optimization problems, genetic structure, components, and case studies in evolutionary computing	Analyse	L4
CO5	Analyse Deep Learning, including deep neural networks, optimization techniques, regularization, convolutional neural networks, transfer learning, and recurrent neural networks	Analyse	L4

Text Book(s):

1. S Sridhar and M Vijayalakshmi, Machine Learning, Oxford Higher Education, 2021

Reference Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Fundamentals of Artificial Intelligence
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AIO6051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:
To make the students to understand the concepts of intelligence, modelling, simulation, knowledge representation, reasoning, issues, expert and fuzzy systems.

UNIT – I	**8 Hours**
Artificial Intelligence: Definitions, Programming Methods, Techniques; Intelligent Systems; Predicate Calculus; Rule-Based Knowledge Representation; Symbolic Reasoning Under Uncertainty; Basic Knowledge Representation Issues.	
Self-study component:	Artificial Intelligence Importance
UNIT – II	**8 Hours**
Heuristic Search: Techniques for Heuristic Search; Heuristic Classification; Intelligent Agents **State Space Search:** Strategies for State Space Search; Learning.	
Self-study component:	Applications of Search Techniques in Game Playing and Planning
UNIT – III	**8 Hours**
Expert Systems: Stages in the development of an Expert Systems; Probability based Expert Systems; Expert System Tools; Applications of Expert Systems.	
Self-study component:	Applications of Expert System
UNIT – IV	**8 Hours**
Introduction to fuzzy systems: Foundation of fuzzy Systems; Linguistic Description and their Analytical Forms; Defuzzification Methods; Fuzzy logic in Control and Decision-making Applications.	
Self-study component:	Fuzzy Relations, Arithmetic Operation of Fuzzy Numbers.
UNIT – V	**8 Hours**
Introduction to Genetic Algorithms: Genetic Algorithms; Procedures of Genetic Algorithms; The working of Genetic Algorithms; Logic behind Genetic Algorithms. Swarm Intelligent Systems Ant Colony Systems; Development of Ant Colony Systems; Applications of Ant Colony Intelligence.	
Self-study component:	Swarm Intelligent System – Background of Ant Intelligent Systems, Importance of the Ant Colony Paradigm.

CO's	**Course Outcomes** with **Action verb** for the Course topics	**Bloom's Level Taxonomy**	**Level Indicator**

CO1	**Analyse** how Artificial Intelligence and Intelligence Systems enable capabilities that are beyond conventional technology.	`Analyse	L3
CO2	**Analyse** how heuristic state-space search algorithms are used to solve complex problems.	Analyse	L3
CO3	**Analyse** and **design** a rule-based expert system with tools.	Analyse	L3
CO4	**Design** fuzzy logic-based controllers and explore their unique characteristics.	Design	L3
CO5	**Applying** genetic algorithms and an outlook on the applications of genetic algorithms.	Apply	L3

Text Book(s):

1. N.P.Padhy: Artificial Intelligence and Intelligent Systems, Oxford University Press, 2017.

Reference Book(s):

1. Efraim Turban, Jay E. Aronson, Ting-Peng Liang**:** Decision Support Systems and Intelligent Systems, VII Edition, Prentice-Hall of India.

Fundamentals of Machine Learning [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P22AIO6052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:
CLO 1. Define machine learning and understand the basic theory underlying machine learning.
CLO 2. Demonstrate the basic concepts of learning.
CLO 3. Explore the basics concept of decision tree and rule based learning.
CLO 4. Illustrate Bayesian techniques and Probabilistic Graphical Models for problems appear in machine learning

UNIT – I	**8 Hours**

Introduction to Machine Learning:
Need for Machine Learning, Machine Learning Explained, Machine Learning in relation to other fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process.

Understanding Data:
Data, Big data analytics and types of analytics, Big data Analysis framework, Descriptive statistics, Univariate data analysis and visualization, Bivariate data and multivariate data, Multivariate statistics, Essential mathematics for multivariate data.

Text book 1: Chapter 1, Chapter 2 (2.1 to 2.8)

Self-study component:	Machine Learning Applications
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Understanding Data:
Overview of Hypothesis, Featured Engineering and Dimensionality Reduction Techniques.

Basics of Learning Theory:
Introduction to Learning and its types, Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning, Induction Biases, Modelling in Machine Learning, Learning Frameworks.

Text book 1: Chapter 2 (2.9 to 2.10), Chapter 3

Self-study component:	Learning Frameworks – Vapnik – Chervonenkis Dimension
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**
Similarity – based Learning: Introduction to similarity or Instance based Learning, Nearest Neighbor Learning, Weighted K – Nearest Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis:** Introduction to Regression, Introduction to Linearity, Correlation and Causation, Introduction to Linear Regression, Validation of Regression Methods, Multiple Linear Regression, Polynomial Regression, Logistic Regression, Reidge and Lasso Regression **Text book 1: Chapter 4 and Chapter 5**	
Self-study component:	Elastic Net Regression
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
UNIT – IV	**8 Hours**
Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Validation and Pruning of Decision Trees. **Rule – based Learning:** Introduction, Sequential Covering Algorithm, First Order Rule Learning, Induction as Inverted Deduction, Inverting Resolution, Analytical Learning or Explanation based Learning, Association Rule Mining **Text book 1: Chapter 6, Chapter 7**	
Self-study component:	Active Learning
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
UNIT – V	**8 Hours**
Bayesian Learning: Introduction to probability based learning, Fundamentals of Bayes Theorem, Classification using Bayes Model, Naïve Bayes Algorithm for continuous attributes. **Probabilistic Graphical Models:** Introduction, Bayesian Belief Network, Markov Chain, Problems solved with HMM **Text book 1: Chapter 8 and Chapter 9**	
Self-study component:	Other popular types of naïve Bayes classifiers
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Understand the basic concept of Machine Learning and data	Understanding	L2
CO2	Apply the basic concept of Learning.	Apply	L3
CO3	Analyse various similarity – based learning and regression algorithms.	Analyse	L4
CO4	Analyse various decision tree and rule based learning	Analyse	L4
CO5	Apply the basics of Bayesian Model and discuss the probabilistic graphical models.	Apply	L3

Text Book(s):

1. S Sridhar and M Vijayalakshmi, Machine Learning, Oxford Higher Education, 2021

Reference Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Fundamentals of Natural Language Processing [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P22AIO6053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the basic concepts and basic algorithms of Natural language processing.
CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers
CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.
CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

UNIT – I	**8 Hours**

Overview and Language Modelling: Origins and Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications, Information Retrieval, Language Modelling, Various Grammar- based Language Models.

Self-study component:	Statistical Language Model.

UNIT – II	**8 Hours**

Word Level Analysis: Regular Expressions, Finite State-Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word Classes, Part of Speech Tagging.

Syntactic Analysis: Context Free Grammar, Constituency, Parsing.

Self-study component:	Probabilistic Parsing.

UNIT – III	**8 Hours**

Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.

Discourage Processing: Cohesion, Reference Resolution

Self-study component:	Demonstrate semantic parsing using Stanford parser

UNIT – IV	**8 Hours**

Natural Language Generation: Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG.
Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, LLM model and ChatGPT

Self-study component:	Translation Involving Indian Languages

UNIT – V	**8 Hours**

Information Retrieval and Lexical Resources:
Information Retrieval: Design features of Information Retrieval Systems, Information Retrieval Models, Classical Information Retrieval Models, Non-Classical Models of IR, Alternative Models of IR, Evaluation of the IR System.
Lexical Resources: Word Net, Frame Net, Stemmers

Self-study component:	Part-of-Speech Tagger, Research Corpora

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Apply various Natural language processing techniques	**L3**	**Apply**
CO2	Analyse the different Natural language processing Techniques	**L2**	**Analyse**
CO3	Design and develop an application using Natural Language Processing tools.	**L4**	**Design**

Text Book(s):

1. Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U S Tiwary, 1st Edition, 2008, Oxford University Press

Reference Book(s):

1. Practical Natural Language Processing, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, June 2020, O'Reilly Media, Inc. ISBN: 9781492054054
2. Natural Language Processing Recipes, Akshay Kulkarni, Adarsha Shivananda, 1st Edition, JAN 2019.

Web and Video link(s):

1. Natural Language processing with python – Analyse text with the natural language toolkit
   URL: www.nltk.org/book_1e d/

Introduction to Full Stack Development [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P22AIO6054**	**Credits:**	**03**
Teaching Hours/Week (L: T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives (CLO)

This course will enable students to

- Understanding the setup and integration of backend components of MEAN stack web application
- Familiarize with basics of Express web framework for server-side programming
- Basic acquaintance with design and development of backend of MEAN stack web application

UNIT – I	**8 Hours**
Introducing MEAN Development: Introducing Node.js: The web server/platform, Introducing Express: The framework, Introducing MongoDB: The database. Introducing Angular: The frontend framework. Designing a MEAN Stack Architecture: A common MEAN stack architecture, looking beyond SPAs, Designing a flexible MEAN architecture.	
Self-study component:	A blog engine architecture.
UNIT – II	**8 Hours**
Real application planning: Planning a real application, Breaking the development into stages. **Creating and setting up a MEAN project:** A brief look at Express, Node, and nap, Creating an Express project.	
Self-study component:	Restarting the application.
UNIT – III	**8 Hours**
MVC architecture: Modifying Express for MVC, Importing Bootstrap for quick, responsive layouts. **Building a static site with Node and Express:** Defining the routes in Express, building basic controllers, Creating some views.	
Self-study component:	Adding the rest of the views
UNIT – IV	**8 Hours**
Building a data model with MongoDB and Mongoose: Connecting the Express application to MongoDB by using Mongoose, why model the data, defining simple mongoose schemas, Using the MongoDB shell to create a MongoDB database and add data.	
Self-study component:	Adding Subdocuments.

UNIT – V			**8 Hours**
Writing a REST API: Exposing the MongoDB database to the application: The rules of a REST API, GET methods: Reading data from MongoDB, POST methods: Adding data to MongoDB, PUT methods: Updating data in MongoDB.			
Self-study component:	Deleting data from MongoDB		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with **Action verbs** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the features and design principles of MEAN stack architecture	Understand	L2
CO2	Use node, express, MongoDB and rest API frameworks to build and integrate backend components	Apply	L3
CO3	Outline structure of backend components and their dependencies and interactions	Apply	L3
CO4	Design and Develop MEAN stack web application for given requirements.	Create	L6

Textbook(s):

1. Simon Holmes, Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node" second edition, 2019.

Reference Book(s):

1. Jake Spurlock, "Bootstrap" First Edition 2013.
2. Steve Fenton "Pro TypeScript - Application-Scale JavaScript Development", Second Edition, A press publications, 2018.
3. Shyam Seshadri, "Angular Up & Running - Learning Angular, Step by Step", First Edition, O'Reilly Media, 2018.

Natural Language Processing Laboratory
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AIL606**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the basic concepts and basic algorithms of Natural language processing.

CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers

CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.

CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

Practical Component topics

1. Installation of libraries NLTK on Python, basic commands to access text
2. Perform Preprocessing (Tokenization, Stop word removal and stemming) of Text
3. Perform Removal of regular expression pattern from textual data
4. Perform Morphological Analysis
5. Implement N-Gram Model
6. Implement Part-of-Speech (POS) Tagging
7. Implement Chunking to extract Noun Phrases
8. Implement Chunking to extract Noun Phrases Identify semantic relationships between the words from given text
9. Case study 1: Identify the Sentiment of tweets
10. Detect hate speech in tweets

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Implement the way N-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories.	Apply	L4
CO2	Implement problems that NLP systems face, natural language outputs construction from non-linguistic inputs and machine translation framework approaches.	Apply	L4

Textbook:

1. Steven Bird, Ewan Klein and Edward Loper: Natural Language Processing with Python 9th Edition, O"REILLY, 2019.

Reference book(s):

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

Mini - Project
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22AIMP607**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. **The marks awarded for the project report shall be the same for all the batch mates.**

(ii) **Interdisciplinary**: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

- **Single discipline**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.
- **Interdisciplinary**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.

EMPLOYABILITY ENHANCEMENT SKILLS - VI
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI for CSE, ISE, ECE, EEE & CSE(AIML) Branches only

Course Code:	**P22HSMC608B**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Calculations involving permutations and combinations, probability, ages and data interpretation.
- Explain concepts behind logical reasoning modules of syllogisms and data sufficiency.
- Prepare students for Job recruitment process and competitive exams.
- Develop problem solving skills through various programming language.

UNIT – I		**06 Hours**

Quantitative Aptitude: Permutation and Combination, Probability, Ages.

Self-study component:	Inferred meaning

UNIT – II		**06 Hours**

Quantitative Aptitude: Data Interpretation.

Logical Reasoning: Syllogisms, Data Sufficiency.

Self-study component:	Chain rule

UNIT – III		**06 Hours**

Soft skills: Group Discussions, Resume Writing, LinkedIn Profiling, Interview Skills.

Interview Preparation: Mock GDs, Resume Validation and Personal Interviews.

Self-study component:	Interpersonal communication

UNIT – IV	**COMPETITIVE CODING - I**	**06 Hours**

Arrays: Find a peak element which is not smaller than its neighbors, K^{th} Smallest largest element, Kadane's Algorithm, Missing number in array, Rearrange Array Alternately, Sort 0s, 1s and 2s, Trapping Rain Water, Chocolate Distribution Problem, Array Leaders, Minimum Number of Platforms Required for a Railway/Bus Station, Rotate a matrix by 90 degree without using any extra space, Find maximum element of each row in a matrix, Print matrix in snake pattern.

Strings: Reverse words in a given string, Converting Roman Numerals to Integer, Find the minimum distance between the given two words, Check whether two Strings are anagram of each other, Remove duplicates from a given string, Multiply Strings, Find largest word in dictionary, Longest Common Prefix, Reduce the string by removing K consecutive identical characters, Check if given String is Pangram or not, Compare Version Numbers.

Self-study component:	Logarithmic Complexity with Binary Search	
UNIT – V	**COMPETITIVE CODING - II**	**06 Hours**

Linked List: Print the Middle of a given linked list, Reverse a Linked List, Reverse a Doubly Linked List, Rotate a Linked List, Delete middle of linked list, Pairwise Swap Nodes of a given Linked List, Remove duplicates from a sorted linked list, Convert singly linked list into circular linked list, Merge two sorted linked lists, check if a singly linked list is palindrome, Insert a node in the 5^{th} position in a singly linked list.

Stacks and Queues: Parenthesis Checker, Reverse a String using Stack, Reverse an array using Stack, Delete Middle element from stack, Find Next Greater Element using Stack, The Stock Span Problem, Reverse First k Elements of Queue, insert one element at front using queue, Implement a Queue using an Array, Maximum number of diamonds that can be gained in K minutes, Sorting a Queue without extra space.

Database: Introduction to database, Types of SQL statements, MySQL commands.

Self-study component:	Schema change statements in SQL.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on Permutation and combination, Probability, ages and data interpretation.	Applying	L3
CO2	Solve logical reasoning problems based on Syllogisms and Data Sufficiency.	Applying	L3
CO3	Apply suitable programming language and / or suitable data structures to solve the given problem.	Applying	L3

Text Book(s):

1. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests by Antti Laaksonen
2. Cracking the Coding Interview by Gayle Laakmann McDowell
3. Fundamentals of Database Systems – Elmasri and Navathe, 6th Edition, Addison-Wesley, 2011.
4. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
5. How to sharpen your interview skills by Prem Vas

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.
2. Data Base System Concepts – Silberschatz, Korth and Sudharshan, 5th Edition, Mc-Graw Hill, 2006
3. An Introduction to Database Systems – C.J. Date, A. Kannan, S. Swamynatham, 8th Edition, Pearson Education, 2006.
4. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/
2. https://onlinecourses.nptel.ac.in/noc22_cs91/
3. https://youtu.be/c5HAwKX-suM
4. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
5. http://nptel.ac.in/courses/106106093/
6. http://nptel.ac.in/courses/106106095/

COURSE ARTICULATION MATRIX

(EMPLOYABILITY ENHANCEMENT SKILLS - VI – P22HSMC608B)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2	1									1

Universal Human Values and Professional Ethics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P22UHV609**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25 + 5**	**SEE Marks:**	**50**

Course objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module - 1

Introduction to Value Education **(3 hours)**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module - 2
Harmony in the Human Being : (3 hours) Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module - 3
Harmony in the Family and Society : (3 hours) Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module - 4
Harmony in the Nature/Existence : (3 hours) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module - 5
Implications of the Holistic Understanding – a Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); • They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. • They would have better critical ability. • They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). • It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. Expected to positively impact common graduate attributes like: 1. Ethical human conduct 2. Socially responsible behavior 3. Holistic vision of life 4. Environmentally responsible work 5. Having Competence and Capabilities for Maintaining Health and Hygiene 6. Appreciation and aspiration for excellence (merit) and gratitude for all

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- CIE paper shall be set for 25 questions, each of the 02 marks. The pattern of the question paper is MCQ (multiple choice question). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

The sum of two tests, will be out of 100 marks and will be scaled down to 50 marks
Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for **50 questions,** each of the 01 marks. **The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books for READING:

Text Book and Teachers Manual

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bageria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
- The Teacher's Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantar, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

Value Education websites,

- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cycle Wala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM