VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(Autonomous)
[AN ISO 9001:2015 Certified Institution]
Affiliated to Periyar University, Approved by AICTE
Re-Accredited with 'A+' Grade by NAAC,
Recognized under section 2(f) & 12(B) of UGC Act, 1956)
Elayampalayam, Tiruchengode (Tk.), Namakkal (Dt.)

& RESEARCH DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS

B.Sc., CS (AI & ML)

Bachelor of Science in Computer Science
(Artificial Intelligence & Machine Learning)

FOR CANDIDATES ADMITTED FROM 2024– 2025
ONWARDS UNDER AUTONOMOUS– OBE PATTERN

Date of Meeting: 22-05-2024

University Nominee Subject Expert Board Chairman

VIVEKANANDHAEDUCATIONALINSTITUTIONS
Elayampalayam, Tiruchengode(Tk), Namakkal(Dt).,

VIVEKANANDHACOLLEGEOFARTSANDSCIENCESFORWOMEN
(AUTONOMOUS)

B.Sc., CS (AI & ML)
Bachelor of Science in Computer Science
(Artificial Intelligence and Machine Learning)

REGULATIONS - R2023

(Candidates admitted from 2023-2024 onwards)

I. SCOPE OF THE PROGRAMME

The IT boom and the rapid growth in science and technology have opened up new vistas of job opportunities. The college offers Bachelor of Science in Computer Science with Artificial Intelligence and Machine Learning which seeks to equip the learners to meet the spiraling demand of the IT industry. It provides special training in computer application of software. The syllabus has been designed at a level equal to that of professional courses. Focus is also on developing soft skills of the students..

II. SALIENT FEATURES

- Qualified and experienced team of faculty members with varied experience in areas of Computer Architecture, Artificial Intelligence, Mobile and Computer Networks, Graphics and Image Processing and Database Management System.
- Motivating of students enhanced with immense expertise, massive technical exposure & structured creative initiatives.
- Industrial visits to various renowned companies are arranged to give an exposure to the students.
- Students are taught by using Audio Visual aids like OHP's & LCD Projectors and modern E-learning
- Course is specially designed for a higher level Career Placement.

III. OBJECTIVES OF THE PROGRAMME

- To produce highly qualified professionals imparting both theoretical and practical knowledge in computer systems and its application.
- To produce fully skilled and trained manpower capable of solving the software & hardware problems, and discovering software solutions related to business organizations.
- To provide an in-depth knowledge of specific sub-disciplines chosen by the students as areas of special interest in the form of elective courses.
- The B.Sc. (AI & ML) Program is aimed at providing a platform for the students to enhance their skills in various fields of Computer Science & Information Technology, like Hardware, Software development, Networking, Database Management & IT enabled services, and to facilitate students to interact with IT professionals, Industry Partners & Academicians from IT and related areas.
- The course is designed to develop computer professionals' versatile use of computers in almost all fields of computer application. The main emphasis of the course is on applied computer use in various fields.

IV. ELIGIBILITYFORADMISSION

A candidate who has passed in Higher Secondary Examination with Mathematics or Business Mathematics or Computer Science or Computer Application or Statistics (Academic stream or Vocational stream) as one of the subjects under Higher Secondary Board of Examination, Tamil Nadu as per norms set by the Government of Tamil Nadu or an examination accepted as equivalent thereto by the syndicate, subject to such conditions as may be prescribed thereto, is permitted to appear and qualify for the Bachelor of Computer Application degree examination after a course of study of three academic years.

V. DURATIONOFTHEPROGRAMME

- The course shall extend over a period of three academic years consisting of six semesters. Each academic year will be divided into two semesters. The First semester will consist of the period from July to November and the Second semester from December to March.
- The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Vivekanandha College of Arts and Sciences for Women with the approval of Periyar University, Salem.
- Each subject will have four to six hours of lecture per week apart from practical training at the end of each semester.

VI. CONTINUOUS INTERNAL ASSESSMENT (CIA)

The performance of the students will be assessed continuously and the Internal.

ASSESSMENTMARKS**FOR THEORY PAPERS** WILL BE AS UNDER:

1) CIA Test I &II(2.5fromeachTest)		-	05
2) Model Exam		-	10
3) Assignment		-	05
4) Attendance		-	05
	Total	-	25

ASSESSMENT MARKS **FOR PRACTICAL PAPERS** WILL BE AS UNDER:

1) Model Exam		-	20
2) Observation Note		-	10
3) Attendance		-	10
	Total	-	40

PASSING MINIMUM- EXTERNAL

Theory	In the End Semester Examinations, the passing minimum shall be 40% out of 75 Marks. (30 Marks)
Practical/ Mini Project	In the End Semester Examinations, the passing minimum shall be 40% out of 60 Marks. (24 Marks)

VII. ELIGIBILITY FOR EXAMINATION

A candidate will be permitted to appear for the University Examination only on learning 75% of attendance and only when her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons, subject to conditions prescribed.

VIII. DISTRIBUTION OF MARKS FOR ATTENDANCE

Attendance Percentage	Marks	
	Theory	Practical
75-80	1	2
81-85	2	4
86-90	3	6
91-95	4	8
96-100	5	10

IX. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the Examination of Core Courses (Main & Allied Subjects) & Securing Marks.

a) 75 % and above shall be declared to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.
b) 60% and above but below 75 % shall be declared to have passed the Examinations in First Class.
c) 50% & above but below 60% shall be declared to have passed the examinations in Second Class.
d) All the remaining successful candidates shall be declared to have passed the examinations in Third Class.
e) Candidates who pass all the examinations prescribed for the course at the First appearance. itself and within a period of Three Consecutive Academic years from the year of admission only will be eligible for University Rank.

X. ELIGIBILITY FOR AWARD OF THE DEGREE

A candidate shall be eligible for the award of the Degree only if she has undergone the above Degree for a period of not less than three academic years comprising of six semesters and passed the examinations prescribed and fulfilled such conditions as have been prescribed therefore.

XI. PROCEDURE IN THE EVENT OF FAILURE

If a candidate fails in a particular subject, she may reappear for the university examination in the concerned subject in subsequent semesters and shall pass the examination.

XII. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2023-24 (i.e.,) for the students who are to be admitted to the First year of the course during the Academic year 2023-24 and thereafter.

XIII. TRANSITORY PROVISIONS

Candidates who were admitted to the UG course of study before 2023-2024 shall be permitted to appear for the examinations under those regulations for the period of three years, i.e., up to and inclusive of the examinations of 2023-2024. Thereafter, they will be permitted to appear for the examinations only under the regulations then in force.

EVALUATION OF EXTERNAL EXAMINATIONS (EE)

QUESTION PAPER PATTERN–THEORY	
Timeduration:3Hours	**Max.Marks:75**
PART- A: (10x1=10)	Answer all the questions. Two questions from each unit.
PART-B: (5x7=35)	Answer all the questions. One question from each unit (Either/or type).
PART- C: (3x10=30)	Answer any three of the questions (3 out of 5). One question from each unit.
IN THE END SEMESTER EXAMINATIONS, THE PASSING MINIMUM SHALL BE 40% OUT OF 75 MARKS. (30MARKS)	

QUESTIONPAPERPATTERN–PRACTICAL	
Timeduration:3Hours	**Max.Marks:60**
1. One compulsory question from the given list of objectives.	**30 Marks**
2. One either/or type question from the given list of objectives.	**30 Marks**
In the end semester examinations, the passing minimum shall be 40% out of 60 marks (24 marks).	

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
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PG & RESEARCH DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS

B.Sc., CS with (AI & ML)
(BACHELOR OF SCIENCE IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

CURRICULUM FOR ACADEMIC YEAR 2024 – 2025

Course Pattern and Scheme of Examinations under Autonomous, OBE Pattern
For the Candidates admitted from the year 2024 – 2025

SEMESTER : I & II

SEM	Part	Course Code	Course Title	Hrs	Credit	Marks		
						CIA	EE	TOT
I	I	23U1LT01	Tamil-I	6	3	25	75	100
	II	23U1LE01	Communicative English– I	4	3	25	75	100
	III	24U1AIC01	Programming in C& C++	5	3	25	75	100
	III	24U1AICP01	Programming in C & C++ Lab	5	4	40	60	100
	III	23U1MAGE03	Allied 01: Numerical Methods	4	3	25	75	100
	IV	23U1ENAC01	AECC 01: Soft Skill for Effective Communication – I	2	2	25	75	100
	IV	24U1CSAC01	AECC 02: Introduction to HTML	2	2	25	75	100
	IV	23U1VE01	Value Education	2	2	25	75	100
	Total			**30**	**22**	**215**	**585**	**800**
II	I	23U2LT02	Tamil-II	5	3	25	75	100
	II	23U2LE02	Communicative English– II	5	3	25	75	100
	III	24U2AIC02	Python Programming	5	4	25	75	100
	III	24U2AICP02	Python Programming Lab	5	4	40	60	100
	III	23U2AIGE02	Allied 02: Operation Research	4	3	25	75	100
	IV	23U2CSAC02	AECC 03: Office Automation	2	2	25	75	100
	IV	SBEC – I		2	2	25	75	100
	IV	23U2EVS01	Environmental Studies	2	2	25	75	100
	Total			**30**	**23**	**215**	**585**	**800**

SEMESTER: III & IV

SEM	Part	Course Code	Course Title	Hrs	Credit	Marks		
						CIA	EE	TOT
III	I	23U3LT03	Language – III	5	3	25	75	100
	II	23U3LE03	English – III	5	3	25	75	100
	III	23U3AIC03	TensorFlow	5	4	25	75	100
	III	23U3AICP03	TensorFlow Lab	5	3	40	60	100
	III	23U3MAGE12	Statistical Methods and their applications – I	4	3	25	75	100
	III	DSE – I	Discipline Elective – I	4	4	25	75	100
	IV	NMEC	Non Major Elective – 01	2	2	25	75	100
			Total	**30**	**22**	**190**	**510**	**700**
IV	I	23U4LT04	Language – IV	5	3	25	75	100
	II	23U4LE04	English – IV	5	3	25	75	100
	III	23U4AIC05	Fundamental of Artificial Intelligence	5	4	25	75	100
	III	23U4AICP04	Artificial Intelligence Lab	5	3	40	60	100
	III	23U4MAGE16	Statistical Methods and their applications – II	4	3	25	75	100
	III	DSE – II	Discipline Elective – II	4	4	25	75	100
	IV	NMEC	Non Major Elective – 02	2	2	25	75	100
			Total	**30**	**22**	**230**	**570**	**800**

SEMESTER:V & VI

SEM	Part	Course Code	Course Title	Hrs	Credit	Marks		
						CIA	EE	TOT
V	III	23U5AIC07	Principles of Robotics	5	4	25	75	100
	III	23U5AIC08	Machine Learning Techniques	5	4	25	75	100
	III	DSE – III	Discipline Elective – III	5	4	25	75	100
	III	DSE – IV	Discipline Elective – IV	5	4	25	75	100
	III	23U5AICP05	Robotics Lab	4	4	40	60	100
	III	23U5AICP06	Machine Learning Lab	4	3	40	60	100
	IV	SBEC – II		2	2	25	75	100
			Total	**30**	**25**	**205**	**495**	**700**
VI	III	23U6AIC09	Natural Language Processing	5	4	25	75	100
	III	23U6AIC10	Data Visualization	5	4	25	75	100
	III	DSE – V	Discipline Elective – V	5	4	25	75	100
	III	DSE – VI	Discipline Elective – VI	5	4	25	75	100
	III	23U6AICP07	Natural Language Processing Lab	4	3	40	60	100
	III	23U6AICPR01	Project Work	4	4	40	60	100
	IV	SBEC – III		2	2	25	75	100
	V		Extension Activities	0	1	0	0	0
			Total	**30**	**26**	**205**	**495**	**700**
			Grand Total	**180**	**140**			

DECIPLINE SPECIFIC ELECTIVES

Course Code	DSE	Course Name	Semester
23U3AIDE01	DSE – I	Sentimental Analytics	Semester: III
23U3AIDE02	DSE – I	Internet of Things	Semester: III
23U4AIDE03	DSE – II	Computer Vision	Semester: IV
23U4AIDE04	DSE – II	Theory of Computation	Semester: IV
23U5AIDE05	DSE – III	Fuzzy Logic and Neural Networks	Semester: V
23U5AIDE06	DSE – III	Big Data Analytics	Semester: V
23U5AIDE07	DSE – IV	Artificial Intelligence & Knowledge Representation	Semester: V
23U5AIDE08	DSE – IV	Reinforcement Learning	Semester: V
23U6AIDE09	DSE – V	Generative AI	Semester: VI
23U6AIDE10	DSE – V	Intelligent Robots and Drone Technology	Semester: VI
23U6AIDE11	DSE – VI	Information Retrieval Techniques	Semester: VI
23U6AIDE12	DSE – VI	Optimization Techniques	Semester: VI

Skill Based Elective Courses (SBEC) (Offer to Same Students)

Course Code	Course Name	Semester
24U2AIS01	Human-Computer Interaction	Semester: II
23U5AIS02	Cyber Security and Ethical Hacking (CDC)	Semester: V
23U5AIS03	Professional Ethics (CDC)	Semester: V
23U6AIS04	Academic Writing and Academic portfolio (CDC)	Semester: VI
23U6AIS05	NoSQL Database (MongoDB)	Semester: VI

B.SC., CS (AI & ML)

VISION OF THE DEPARTMENT

- To provide high academic goals to the students and make them the world leaders both in educational and research through effective teaching

MISSION OF THE DEPARTMENT

- To create, share and apply knowledge in Computer Science, including interdisciplinary areas that extend the scope of Computer Science and benefit humanity.
- To educate students to be successful, ethical and effective problem solvers.
- To prepare the students to contribute positively to the economic well-being of our region and nation.

PROGRAMME OBJECTIVES

- Students will establish themselves as effective professionals by solving real problems through the use of computer science knowledge and with attention to teamwork, effective communication, critical thinking, and problem-solving skills.
- Students will develop professional skills that prepare them for immediate employment and for lifelong learning in advanced areas of computer science and related fields.
- Students will demonstrate their ability to adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
- Students will be provided with an educational foundation that prepares them for their excellence.
- Students will prepare for leadership roles along diverse career paths with encouragement to professional ethics and active participation needed for a successful career.

PROGRAMME EDUCATIONAL OBJECTIVES:

- **Technical Competence:** Graduates will possess strong foundational knowledge in computer science and specialized skills in artificial intelligence and machine learning, enabling them to design, develop, and deploy innovative solutions.
- **Problem-Solving and Critical Thinking:** Graduates will be able to analyze complex problems, apply critical thinking, and utilize AI and ML techniques to develop effective solutions.
- **Professional Excellence:** Graduates will demonstrate expertise in their chosen profession, exhibiting professionalism, ethical awareness, and social responsibility.
- **Social Responsibility and Ethics:** Graduates will understand the social implications of AI and ML, demonstrating ethical awareness, responsibility, and commitment to using technology for societal benefit.
- **Lifelong Learning:** Graduates will stay updated with cutting-edge technologies, pursue continuous learning, and adapt to the evolving AI and ML landscape.
- **Entrepreneurial and Employability Skills:** Graduates will possess skills to become employable, entrepreneurial, or pursue higher education, contributing to the

economic and social development of their communities.

- **Social Impact:** Graduates will understand the social implications of AI and ML and strive to create positive impacts in their communities.
- **Research and Innovation:** Graduates will be able to apply AI and ML concepts to real-world problems, demonstrating research skills, creativity, and innovation.

PROGRAMME OUTCOMES:

1. Apply the knowledge of mathematics and science to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyze complex problems reaching substantiated conclusions using first principles of mathematics, natural sciences.
3. Design solutions for complex problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. 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. Create, select, and apply appropriate techniques, resources, and modern tools including prediction and modeling to complex activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.
7. Understand the impact of the solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PROGRAMME SPECIFIC OUTCOMES:

Program Specific Outcomes (PSOs) for a B.Sc in Computer Science with specialization in Artificial Intelligence and Machine Learning typically include the following: Graduates will be able to

- Demonstrate the knowledge of human cognition, Artificial Intelligence, Machine Learning and data engineering for designing intelligent systems.
- Apply computational knowledge and project development skills to provide innovative solutions
- Use tools and techniques to solve problems in AI and ML.

SEMESTER – I

Subject Title	PROGRAMMING IN C & C ++	Semester	I
Subject Code	24U1AIC01	Specialization	NA
Type	Core 01: Theory	L:T:P:C	5:0:0:4

Course objective:

1. Understanding the basics of getting started with c programming
2. Observe the various conditions of c programming
3. Understand the looping structures of c programming
4. Understanding the basics of getting started with c++ programming

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	Recognize basics of C programming	K1
CO2	Describe various conditions of C programming	K2
CO3	Demonstrate looping structures of C programming	K3
CO4	Recognize basics of C programming	K4
CO5	Understand the Language features	K5

Unit	Contents	No. of Sessions
I	**Introduction to C Programming :** **Overview of C:** Basic structure of C program. **Constants, Variable and Data Types**: Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Assigning Values to Variables.	12
II	**C Operators :** Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators, Special Operators, **CONTROL STRUCTURES:** Simple IF Statement, the IF-ELSE Statement, Nesting of IF-ELSE Statements, The ELSE IF Ladder, The Switch statement, The ? : Operator, The goto statement. **Looping:** Introduction, The while Statement, The do statement, The for statement.	12
III	**Introduction to Arrays and Strings - Arrays:** One-dimensional Arrays, Two-dimensional Arrays – multi dimensional arrays. **Strings:** Declaring and Initializing String Variables, String-handling Functions. **Introduction to Functions and Pointers:** Definition for functions, Function Declaration, Types of functions, Recursion **Pointers:** Declaring & Initialization of Pointer Variables, accessing a Variable through its Pointer, Pointer Expressions.	12
IV	**introduction to Object Oriented Programming:** **Classes & Objects:** Class Specifier, Defining data members and member functions, Array of objects, Object as function argument- Returning Object. **Function in 'C++' :** Function overloading and default arguments, Inline	12

	function, Friend functions, Virtual Functions	
V	**OOPS Concepts :** Constructors and Destructor, Operator Overloading and Type conversion, Inheritance and Polymorphism, Working with files, Exception Handling	**12,**

Learning Resources	
Text Books	1. McGraw Hill, E.Balagurusamy,"Programming in ANSIC", Sixth Edition, 2. McGraw Hill, E.Balagurusamy,"Object Oriented Programming with C++", Fifth Edition,
Reference Books	1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language" 2. Stanley B. Lippman, JoséeLajoie, and Barbara E. Moo, "C++ Primer"
Website/Link	1. https://learn-c.org/ 2. https://www.learncpp.com/ 3. https://cplusplus.com/

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	PROGRAMMING IN C & C ++ LAB	Semester	I
Subject Code	24U1AICP01	Specialization	NA
Type	Core 01: Practical	L:T:P:C	0:0:5:4

Course objective:

1. Understanding the basics of getting started with c programming
2. Observe the various conditions of c programming
3. Understand the looping structures of c programming
4. Understanding the basics of getting started with c++ programming

LIST OF EXPERIMENTS:

1. Write a C program to find sum and average of three numbers
2. Write a C program to generate prime numbers between 1 to n
3. Write a C program to check whether a given number is a perfect number or not.
4. Write a C program to find the roots of a quadratic equation.
5. Write a C program to find factorial of a given integer using non-recursive function.
6. Write a C++ program to display Names, Roll No., and grade of 3 students who have appeared in the examination. Declare the class of name, rollno, and grade. Create an array of class objects. Read and display the contents of the array.
7. Given that EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary, and print data members.
8. Write a C++ program to read the data of N employee and compute the net salary of each employee (DA=52% of basic and IT=30% of gross salary).
9. Write a C++ program to create multilevel inheritance
10. Write a C++ program to create an array of pointers. Invoke functions using array objects

Subject Title	INTRODUCTION TO HTML	Semester	I
Subject Code	24U1CSAC01	Specialization	NA
Type	CORE: Theory	L:T:P:C	2:0:0:2

COURSE OBJECTIVE:

- Understand the principles of creating an effective web page.
- Become familiar with graphic design principles that relate to web design .
- Implement these theories into practice.
- Develop skills in analyzing the Social sites.
- Understand how to plan and conduct user research related to web usability.

CO No.	CO Statement	Knowledge Level
CO1	Knows the basic concept in HTMLConcept of resources in HTML	K1
CO2	Knows Design concept, Concept of Meta Data Understand the concept of save the files.	K2,K4
CO3	Understand the page formatting, Concept of list	K3
CO4	Creating Links, Know the concept of creating link to email address	K4
CO5	Concept of adding images, Understand the table creation.	K4

UNIT	Contents	No. of Sessions
I	Introduction: Web Basics: What is Internet–Web browsers–What is Webpage –HTML Basics: Understanding tags.	4
II	Tags for Document structure (HTML, Head, Body Tag). Block level text elements: Headings paragraph (<p> tag)–Font style elements: (bold, italic, font, small, strong, strike, big tags)	4
III	Lists: Types of lists: Ordered, Unordered– Nesting Lists–Other tags: Marquee, HR, BR-Using Images –Creating Hyperlinks.	4
IV	Tables: Creating basic Table, Table elements, Caption–Table and cell alignment–Rowspan, Colspan–Cell padding.	4
V	Frames: Frameset–Targeted Links–No frame–Forms: Input, TextArea, Select, Option.	4

LEARNINGRESOURCES	
TextBooks	"Mastering HTML5 and CSS3 Made Easy", Teach U Comp Inc., 2014.
Reference Book	Thomas Michaud, "Foundations of Web Design: Introduction to HTML & CSS"
WebsitE/Link	https://www.w3schools.com/html/default.asp

MAPPING WITH PROGRAMME OUTCOMES

	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	-
CO2	S	M	M	S

CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong,M-Medium,L– Low

SEMESTER – II

Subject Title	PYTHON PROGRAMMING	Semester	II
Subject Code	24U2AIC02	Specialization	NA
Type	Core: Theory	L:T:P:C	5:0:0:4

Course objective:

- Build basic programs using fundamental programming constructs like variables, conditional logic, looping, and functions
- Work with user input to create fun and interactive programs
- Create simple games with images, animations, and audio using our custom beginner-friendly programming
- Describe the core syntax and semantics of Python programming language.

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	Develop and execute simple Python programs	K1
CO2	Decompose a Python program into functions	K2
CO3	Write simple Python programs using conditionals and looping for solving problems	K3
CO4	Represent compound data using Python lists, tuples, dictionaries etc.	K5
CO5	Read and write data from/to files in Python programs	K4

Unit	Contents	No. of Sessions
I	Introduction: The essence of computational problem solving – Limits of computational problem solving - Computer algorithms - Computer Hardware - Computer Software - The process of computational problem solving - Python programming language - Literals - Variables and Identifiers - Operators - Expressions and Data types, Input / output	12
II	Control Structures: Boolean Expressions - Selection Control - If Statement - Indentation in Python - Multi-Way Selection - Iterative Control - While Statement - Infinite loops - Definite vs. Indefinite Loops- Boolean Flag. String, List and Dictionary, Manipulations Building blocks of python programs, Understanding and using ranges.	12
III	Functions: Program Routines - Defining Functions - More on Functions: Calling Value-Returning Functions - Calling Non-Value - Returning Functions- Parameter Passing - Keyword Arguments in Python - Default Arguments in Python - Variable Scope.	12
IV	Objects and their use: Software Objects - Turtle Graphics – Turtle attributes-Modular Design: Modules - Top-Down Design - Python Modules - Text Files: Opening, reading and writing text files – String Processing- Exception Handling.	12

V	Dictionaries and Sets: Dictionary type in Python - Set Data type. Object Oriented Programming using Python: Encapsulation - Inheritance – Polymorphism. Recursion: Recursive Functions.	**12**

Learning Resources	
Text Books	1. Charles Dierbach, "Introduction to Computer Science using Python - A computational Problem solving Focus", Wiley India Edition, 2015.
Reference Books	• Mark Lutz, "Learning Python Powerful Object Oriented Programming", O'reilly Media 2018, 5th Edition. • Timothy A. Budd, "Exploring Python", Tata MCGraw Hill Education Private Limited 2011, 1 st Edition. • John Zelle, "Python Programming: An Introduction to Computer Science", Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410 • Michel Dawson, "Python Programming for Absolute Beginers" , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009
Website/Link	http://bedford-computing.co.uk/learning/wp-content/uploads/2015/10/Introduction-to-Computer-Science-Using-Python.pdf

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	PYTHON PROGRAMMING LAB	Semester	II
Subject Code	24U2AICP02	Specialization	NA
Type	Core 02: Theory	L:T:P:C	0:0:5:4

Course objective:

- Acquire programming skills in core Python.
- Acquire Object-oriented programming skills in Python.
- Develop the skill of designing graphical-user interfaces (GUI) in Python.
- Develop the ability to write database applications in Python.
- Acquire Python programming skills to move into specific branches

LIST OF EXPERIMENTS:

1. Write a program to demonstrate different number data types in Python
2. Write a program to perform different Arithmetic Operations on numbers in Python.
3. Write a Python program using List, Tuples and List comprehensions
4. Write a Python program using Control statements
5. Write a Python program using Functions and String Operations
6. Write a Python program using Text Files
7. Write a Python program using Exceptional Handling
8. Write a Python program using Inheritance
9. Write a program to demonstrate working with dictionaries in python.
10. Write a python program to find factorial of a number using Recursion

Subject Title	HUMAN COMPUTER INTERACTION	Semester	II
Subject Code	24U2AIS02	Specialization	NA
Type	CORE: THEORY	L:T:P:C	2:0:0:2

COURSE OBJECTIVE:

1. Understand Fundamental HCI Concepts
2. Develop Skills in Designing User Interfaces
3. Apply User-Centered Design (UCD) Methodology

CO No.	CO Statement	Knowledge Level
CO1	Students will understand human cognitive processes, memory, emotions, and individual differences to enhance interaction design and usability.	K1
CO2	Students will understand computer hardware, including input devices, displays, memory, and paper, to improve system design and user interfaces.	K2, K4
CO3	Students will learn interaction models, ergonomic design, and interface styles to create effective user interfaces, including 2D/3D navigation and WIMP elements.	K3
CO4	Students will apply design principles, user focus, and iterative prototyping to create effective screen layouts and incorporate HCI in the software life cycle to improve usability and design rationale.	K1, K2
CO5	Students will analyze and apply design rules, principles, standards, and heuristics to enhance usability and interface effectiveness	K4

Unit	Contents	No. of Hrs
I	**The human:** Introduction - Input–Output channels - Human memory - Thinking: Reasoning and Problem Solving - Emotion - Individual differences.	6
II	**The Computer:** Introduction - Text entry devices - Positioning, pointing and drawing - Display devices - Paper: printing and scanning – Memory.	6
III	**The interaction:** Introduction - Models of interaction - Frameworks and HCI – Ergonomics: Design Focus: Industrial interfaces - Interaction styles: Design Focus: Navigation in 3D and 2D - Elements of the WIMP interface - Design Focus: Learning toolbars – Interactivity.	6

IV	**Interaction design basics:** What is design - The process of design - User focus – Screen design and layout - Iteration and prototyping. **HCI in the software process:** The software life cycle - Usability engineering - Iterative design and prototyping - Design rationale.	**6**
V	**Design rules:** Introduction - Principles to support usability – Standards – Guidelines - Golden rules and heuristics - HCI patterns.	**6**

Learning Resources	
Text book	Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human -Computer Interaction", 3rd Edition, Pearson Education, 2004.
Reference book	Serengul Smith-Atakan, "Human-Computer Interaction: Basics and Practice", Bentham books.
Website / Link	https://www.tutorialspoint.com/human_computer_interface/index.htm

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	S	S	M	S
CO2	S	M	M	S	S	M	S	S	M	S
CO3	S	M	M	S	S	M	M	S	M	S
CO4	S	M	M	S	M	M	M	S	M	S
CO5	S	M	M	S	M	M	M	S	M	S

S – Strong , M – Medium, L – Low (may be avoided)

SEMESTER – III

Subject Title	TENSORFLOW	Semester	III
Subject Code	23U3AIC03	Specialization	AI
Type	Core: III	L:T:P:C	5 : 0 : 0 : 4

Course objective:

- The students able will work in Python programming language.
- The students will be proficient in designing and implementing Neural Networks using Tensor Flow.

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	After completing Unit 01, the students will understand the basics of Python	K1
CO2	After completing Unit 02, the students will Develop proficiency in iterations, generators, comprehensions, string handling techniques, and function implementation, enhancing problem-solving skills and program efficiency.	K1, K2
CO3	After completing Unit 03, the students will Acquire foundational skills in NumPy for array creation and manipulation, and explore basic image processing techniques including reading, writing, contouring, and basic transformations.	K2, K3
CO4	After completing Unit 04, the students will demonstrate proficiency in selecting and implementing appropriate machine learning and deep learning techniques for solving a wide range of real-world problems	K2, K4
CO5	After completing Unit 05, the students will demonstrate competency in the fundamentals of TensorFlow.	K1, K3, K5

Unit	Contents	No. of Hours
I	Introduction to Python: Introduction – Features of Python – The paradigms. Python objects: Introduction – Basic Data Types Revisited – Strings – List & Tuples. Conditional Statements: If, If-Else and If-Elif-Else-Else Constructs – The If-Elif-Else Ladder. Looping: While – Patterns.	10
II	Iterations, Generators and Comprehensions: The power of 'For' – Iterators – Generators – Comprehensions. Strings: The use of 'For' and 'while' – The string Operators – Functions for String Handling. Functions: Features of a Function – Basic Terminology – Definition and Invocation – Types of functions – Implementing Search – Scope - Recursion.	10
III	Introduction to Numpy: Introduction to Numpy and Creation of a basic Array – Functions for generating sequences – Aggregate functions – Broadcasting – Structured Arrays. Introduction to Image processing:	10

	Opening, Reading and Writing an Image – The Contour Function – Clipping – Statistical Information of an Image – Basic Transformation.	
IV	Introduction to Deep Learning &TensorFlow: Machine Learning Eats Computer Science – Deep Learning Primitives: Fully Connected Layer – Convolutional Layer – Recurrent Neural Network Layer Long Short – Term Memory Cells – Deep Learning Architectures: LeNet – AlexNet – ResNet – Neural Captioning Model. Introducing Tensors: Scalars, Vectors, and Matrices – Matrix Mathematics – Tensors. Basic Computations in TensorFlow: Installing TensorFlow and Getting Started – Initializing Constant Tensors – Sampling Random Tensors. Tensor Addition and Scaling – Matrix Operations – Tensor Types – Tensor Shape Manipulations.	**15**
V	Convolutional Neural Networks: Introduction to Convolutional Architectures: Local Receptive Fields - Convolutional Kernels - Pooling Layers. Applications of Convolutional Networks: Object Detection and Localization - Image Segmentation - Graph Convolutions Generating Images with VariationalAutoencoders. Recurrent Neural Networks: Overview of Recurrent Architectures: Recurrent Cells - Long Short-Term Memory (LSTM) - Gated Recurrent Units (GRU) - Applications of Recurrent Models: Sampling from Recurrent Networks - Seq2seq Case Study: Deep Learning for Robotics - Deep Learning in Agriculture	**15**

Learning Resources	
Text Books	1. Harsh Bhasin, "Python for Beginners", New age International Publishers, 2019 (U1, U2, U3). 2. Reza BosaghZadeh, BharathRamsundar, "TensorFlow for Deep Learning", 2018 Architecture, Pearson Education (U4 & U5).
Reference Books	1. Tom Hope, Yehezkel S. Resheff, and Itay Lieder, "Learning TensorFlow - A Guide to Building Deep Learning Systems", 2017, O'Reilly. 2. Giancarlo Zaccone, Md.RezaulKarim, Ahmed Menshawy "Deep Learning with Tensorflow", 2017. 3. Francois Chollet, "Deep Learning with Python", 2017.
Website/ Link	1. https://www.tensorflow.org/learn 2. https://www.tensorflow.org/resources/learn-ml/basics-of-machine-learning

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	S	S	M	S
CO2	S	M	M	S	S	M	S	S	M	S
CO3	S	M	M	S	S	M	M	S	M	S
CO4	S	M	M	S	M	M	M	S	M	S
CO5	S	M	M	S	M	M	M	S	M	S

S – Strong , M – Medium, L – Low (may be avoided)

Subject Title	TENSORFLOW LAB	Semester	III
Subject Code	23U3AICP03	Specialization	AI
Type	Core: III	L:T:P:C	0:0:5:3

Course objective:

- ❖ Tounderstandbasicoperations,constant,variablesetc.
- ❖ Tounderstandlinearandnonlinearregressions.

CourseOutcomes:

- ❖ Thestudentwillbeabletounderstandtheconceptvariables, andDataTypes,Operators &Expressions
- ❖ Thestudentwillbeabletounderstandtheconceptsoflinearandnonlinearregressions.
- ❖ Thestudentwillbeabletounderstand theconceptsofvariablesharingprinciple.
- ❖ The studentwill be abletounderstandthe conceptsofencoder withtransformer
- ❖ Thestudentwillbeabletounderstandtheconceptsofreinforcementlearningin tensorflow.

LISTOFPRACTICALEXCERCISES
(All the Exercises can work in Python Programming)

1. Find whether number entered by the user is divisible by 3 and 13.
2. Find whether number entered by the user is perfect square.
3. Write the Python program to enter the values of a & b and calculate a to the power of b, using recursion.
4. Write a generator to produce Geometric progression, where in the first term, the common ratio and the number of terms is entered by the user.
5. Write a Python program to find the ASCII values of the characters of a given string.
6. Create a two dimensional array with 7x7, such that an element of a_{ij} (Element at the i^{th} row and j^{th} column) is $(i+j)^2$.
7. Implement concepts of Basic Operations, Constants and Variables.
8. Implement concepts of Control Dependencies
9. Implement concepts of Variational Auto-Encoders
10. Implement concepts of Recurrent Neural Networks

Subject Title	SENTIMENTANALYSIS	Semester	III
Subject Code	23U3AIDE01	Specialization	AI
Type	Elective: 01 – Theory	L:T:P:C	4:0:0:4

Course objective:

5. Tointroducetocomputationalstudyofpeople'sopinions,sentiments,emotions,moods,andattitudes

CO No.	CO Statement	Knowledge Level
CO1	Tounderstandthe underlyingstructureoftheproblemcommonlyused to express opinions, sentiments, and emotions	K1
CO2	Tounderstandthe underlyingstructureofthelanguage constructscommonlyused to express opinions, sentiments, and emotions	K2
CO3	Tounderstandcoreareasofsentimentanalysis	K3
CO4	Tounderstandrules and extraction of entity in sentimentanalysis	K4
CO5	Tounderstand sentiment lexicon generation	K4

Unit	Contents	No. of Sessions
I	Introduction,Sentimentanalysisapplications,Sentimentanalysisresearch,Sentiment analysisasmini-NLP,TheProblemofSentimentAnalysis, Definitionofopinion,Definitionofopinionsummary.	12
II	Differenttypesofopinions,DocumentSentimentClassification,Supervisedsentiment classification,Unsupervisedsentimentclassification,Sentimentratingprediction, Cross-Domain Sentiment Classification, Cross-Language Sentiment Classification.	12
III	SentenceSubjectivityandSentimentClassification,Subjectivity,SentenceSubjectivityClassification,SentenceSentimentClassification,AspectSentimentClassification	12
IV	RulesofSentimentcomposition,NegationandSentiment,AspectandEntityExtraction ,Frequencybasedaspect extraction, Exploringsyntacticrelations, Usingsupervised learning	12

V	SentimentLexiconGeneration,Dictionarybasedapproach,Corpusbasedapproach,Sentimentwordembedding,AnalysisofComparativeOpinions,Problemdefinition,Identifyingcomparativesentences,Identifyingthepreferredentity set,Specialtypesofcomparison	**12**

Learning Resources	
Text Books	SentimentAnalysis:MiningOpinions,Sentiments,andEmotions,byBingLiu
Reference Books	1. SentimentAnalysisinSocialNetworksByFedericoPozzi,ElisabettaFersini,EnzaMessina,BingLiu · 2016 2. SentimentAnalysisforSocialMedia,AntonioMoreno,CarlosA.Iglesias,MDPI2020 3. NewOpportunitiesforSentimentAnalysisandInformationProcessing,AakanshaSharaff,G. R. Sinha, Surbhi Bhatia,IGIGlobal, 2021 4. SentimentAnalysisandKnowledgeDiscoveryinContemporaryBusiness, DharmendraSinghRajput, Ramjeevan SinghThakur, S. MuzamilBasha,IGIGlobal, 2018
Website/ Link	https://www.analyticsvidhya.com/blog/2021/06/nlp-sentiment-analysis/ https://www.geeksforgeeks.org/what-is-sentiment-analysis/

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject title	INTERNET OF THINGS	Semester	III
Subject code	23U3AIDE02	Specialization	CA
Type	Elective 01: Theory	L:T:P:C	4:0:0:3

COURSEOBJECTIVE:

- To know about the IoT concepts.
- To understand the development of Internet of Things prototypes.
- To understand the concepts of sensing, actuation and communications.
- Students will be explored to the interconnection and integration of the physical and the cyber space.

COURSEOUTCOME:

CONo.	COStatement	Knowledge Level
CO1	Comprehend the essentials of IoT and its applications	K1
CO2	Analyze and understand the various IoT data link and network layer protocols.	K2
CO3	Understand the concepts of IoT Architecture Reference model and IoT reference architecture.	K3
CO4	Demonstrate the operation of processing unit.	K5
CO5	Recognize the operation of parallel processing.	K4

Unit	Contents	No. of Hours
I	**Introduction** Introduction to IoT: Definition & characteristics of IoT– Physical Design of IoT: Things in IoT, IoT protocols. Logical Design of IoT: IoT functional blocks – IoT Communication Models.	10
II	**IoT enabled Technologies** Wireless Sensor Networks, Cloud computing, Big data Analytics, Communication protocols, Embedded Systems. IoT Levels & Deployment Templates.	10
III	**Domain Specific IoTs** Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.	10
IV	**IOT Platforms design methodology** IOT Platforms design methodology - Introduction, IOT Design methodology – Case study on IoT system for weather monitoring.	10
V	**IoT Systems logical design using Python** Introduction- Installing python - Python data types and data structures - Control Flow – Functions – Modules – Packages – File Input / Output – Date / Time Operations – Classes.	10

Learningresources	
Textbooks	1. Internet of Things - A Hands on Approach, ArsdeepBahga& Vijay Mandisetti, 2015, ISBN : 9788173719547.
Reference books	1. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI 2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer. 3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
Website/link	1. http://internetofthingsagenda.techtarget.com/ 2. http://www.businessinsider.com/what-is-the-internet-of-things 3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

MAPPING WITH PROGRAMME OUTCOMES

	PO01	PO02	PO03	PO04
CO1	S	S	S	M
CO2	S	M	S	S
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	S	M	L

S-Strong,M-Medium,L–Low

SEMESTER – IV

Subject Title	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	Semester	IV
Subject Code	23U4AIC05	Specialization	NA
Type	Core: Theory - V	L:T:P:C	5:0:0:4

Course objective:

1. Understand AI Concepts: Grasp the fundamental principles and theories that underpin AI, including machine learning, neural networks, natural language processing, and computer vision.
2. Develop Problem-Solving Skills: Apply AI techniques to solve complex problems in various domains by formulating appropriate models and algorithms.
3. Implement AI Algorithms: Gain practical experience in designing, coding, and debugging AI algorithms using popular programming languages and tools.
4. Analyze AI Systems: Critically evaluate the performance and limitations of different AI systems and techniques, understanding their strengths and weaknesses in various contexts.

CO No.	CO Statement	Knowledge Level
CO1	Understand and articulate fundamental AI concepts, including the nature of AI problems, underlying assumptions, techniques, modeling levels, success criteria, state space search, production systems, and problem characteristics.	K1
CO2	Apply and evaluate heuristic search techniques, including generate and test, hill climbing, best-first search, problem reduction, constraint satisfaction, and means-ends analysis, to effectively solve complex AI problems.	K2
CO3	Effectively utilize and differentiate various knowledge representation techniques, including procedural and declarative knowledge, logic programming, reasoning methods, and matching, to solve AI-related problems.	K2, K3
CO4	Develop proficiency in both symbolic and statistical reasoning techniques for solving complex AI problems, encompassing nonmonotonic reasoning, Bayesian methods, and rule-based systems.	K4
CO5	Gain expertise in game playing strategies, planning methodologies, and comprehension techniques, including the minimax search procedure, alpha-beta pruning, and nonlinear planning using constraints.	K2, K3

Unit	Contents	No. of Sessions
I	**Basics of Artificial Intelligence:** What is Artificial Intelligence - The AI Problem - The Underlying Assumption - AI Techniques - The level of the Model - criteria for success - Defining the Problem as a State Space Search - Production System - Problem Characteristics?	12
II	**Heuristic Search Techniques:** Issues in Design of Search Programs - Generate and Test - Hill climbing - Best-first search - Problem Reduction - Constraint satisfaction - Mean-ends Analysis.	12
III	**Knowledge Representation:** Representation and Mappings - Approaches to knowledge representation - Issues in Knowledge Representation - Procedural Versus Declarative Knowledge - Logic Programming - Forward Versus Backwand Reasoning - Matching	12
IV	**Symbolic and Statistical Reasoning:** Introduction to Nonmonotonic Reasoning - Logics for Nommonotonic Reasoning - Implementation Issues - Probability and Bayes Theorem - Certainty Factors and Rule-based Systems - Bayesian Networks - Dempster-Shafer Theory.	12
V	**Game Playing, Planning, Understanding:** The Minimax Search Procedure - Adding Alpha beta cut-off - Additional Refinement - Planning Overview, components of planning system - Nonlinear Planning Using Constraint.	12

Learning Resources	
Text Books	1. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence" PHI, 2018.
Reference Books	1. Michael Negnevitsky "Artificial Intelligence: A Guide to Intelligent Systems", TMH, 2nd Ed, 2016. 2. David L. Poole and Alan K. Mackworth , "Artificial Intelligence: Foundations of Computational Agents", 4th Ed, TMH, 2018.
Website/Link	https://www.edureka.co/blog/knowledge-representation-in-ai/

Mapping with Programme Outcomes

	PO01	PO02	PO03	PO04
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	ARTIFICIAL INTELLIGENCE LAB	Semester	IV
Subject Code	23U4AICP04	Specialization	NA
Type	Core: Practical: VI	L:T:P:C	0:0:5:3

Course objective:

5. Understand AI Concepts: Grasp the fundamental principles and theories that underpin AI, including machine learning, neural networks, natural language processing, and computer vision.
6. Develop Problem-Solving Skills: Apply AI techniques to solve complex problems in various domains by formulating appropriate models and algorithms.
7. Implement AI Algorithms: Gain practical experience in designing, coding, and debugging AI algorithms using popular programming languages and tools.
8. Analyze AI Systems: Critically evaluate the performance and limitations of different AI systems and techniques, understanding their strengths and weaknesses in various contexts.

List of Experiments:

1. Write a program to implement DFS
2. Write a program to implement BFS
3. Write a Program to find the solution for travelling salesman Problem
4. Write a program to implement Simulated Annealing Algorithm
5. Write a program to find the solution for wampus world problem
6. Write a program to implement 8 puzzle problem
7. Write a program to implement Towers of Hanoi problem
8. Write a program to implement A* Algorithm
9. Write a program to implement Hill Climbing Algorithm
10. Build a BOT which provides all the information related to you in college.

Subject Title	COMPUTER VISION	Semester	IV
Subject Code	23U4AIDE03	Specialization	NA
Type	Elective-II - Theory	L:T:P:C	4:0:0:4

Course objective:

1. To learn about image representation and techniques of image analysis
2. To gain the knowledge about pattern recognition and image classifier of the image towards computer vision enhancement.
3. To gain the knowledge about the image color and shading.

CO No.	CO Statement	Knowledge Level
CO1	To study about imaging and image representation	K1
CO2	To learn about the techniques of Binary Image Analysis and Morphology	K2
CO3	To gain the knowledge about the Pattern Recognition and classifier of the image.	K3
CO4	To implement the Image Filtering and Enhancing Techniques	K4
CO5	To gain the knowledge about the image Color and Shading of an image.	K5

Unit	Contents	No. of Sessions
I	Introduction: Machines that see?- Application Problems-Operations on Images- The Good, the Bad, and the Ugly- Use of Computers and Software. Imaging and Image Representation: Sensing Light – Imaging Devices- Problems in Digital Images- Picture Functions and Digital Images- Digital Image Formats- Richness and Problems of Real Imagery- 3D Structure from 2D Images.	12
II	Binary Image Analysis: Pixel and Neighborhoods- Applying Masks to Images- Counting the Objects in an Image – Connected Components Labeling- Binary Image Morphology: Structuring Elements, Basic Operations, Some Applications of Binary Morphology, Conditional Dilation- Region Properties- Region Adjacency Graphs- Thresholding Grayscale Images- The Use of Histograms for Threshold selection- Automatic Thresholding.	12
III	Pattern Recognition: Pattern Recognition Problems- Common model for classification- Precision versus recall- Features used for representation- Feature Vector Representation- Implementing the Classifier- Structural	12

	Techniques- The Confusion Matrix- Decision Trees- Bayesian decision Making- Decisions using Multidimensional Data- Machines the Learn- Artificial Neural Nets.	
IV	Filtering and Enhancing Images: What needs fixing- Grey level mapping- Histogram equalization- Removal of Small Image Regions- Removal of Salt and Pepper Noise- Removal of Small Components - Image smoothing- Detecting Edges using Differencing Masks.	**12**
V	Color and Shading: Some Physics of Color- Sensing Illuminated Objects – Additional Factors – Sensitivity of Receptors- The RGB Basis for Color- Other Color Bases- CMY Subtractive Color System- HSI- YIQ, YUV for TV Signals- Color Histograms- Color Segmentation.	**12**

Learning Resources	
Text Books	1. Linda Shapiro, George Stockman, “Computer Vision”, 2018.
Reference Books	1. Mubarak Shah, “Fundamentals of Computer Vision” 2. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2019.
Website/Link	http://szeliski.org/Book/.

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

SubjectTitle	THEORY OF COMPUTATION	Semester	IV
SubjectCode	23U4AIDE04	Specialization	AI
Type	Elective 02: Theory	L:T:P:C	4:0:0:4

Courseobjective:

1. Define a system and recognize the behavior of a system.
2. Design finite state machines and the equivalent regular expressions.
3. Construct pushdown automata and the equivalent context free grammars
4. Design Turing machines and Post machines
5. Learn about the issues in finite representations for languages and machines, as well as gain a more formal understanding of algorithms and procedures.

CO No.	COStatement	Knowledge Level
CO1	Relate formal languages and mathematical models of computation	K1
CO2	Attain knowledge about different types of languages and the corresponding machines	K1,K2
CO3	Learn about the pushdown machine and its role in compiler construction	K3
CO4	Understand the capability of real computers and learn examples of unsolvable problems.	K4
CO5	Analyse classes of P, NP, NP-C and NP-Hard problems	K5

Unit	Contents	No. of Hours
I	**Mathematical Tools and Techniques:** Logic and Proofs,Sets,Functions and Equivalence Relations,Languages,Recursive Definitions,Structural Induction. **Finite Automata and the Languages They Accept:Finite Automata:** Examples and Definitions,Accepting the Union, Intersection, or Difference of Two Languages	12
II	**Regular Expressions, Nondeterminism, and Kleene's Theorem:** Regular Languages And Regular Expressions, Nondeterministic Finite Automata, The Nondeterminism in an NFA Can Be Eliminated, Kleene's Theorem, Part 1, Kleene's Theorem Part 2. **Context Free Languages:** Using Grammar Rules to Define a Language, Context-Free Grammars: Definitions and More Examples, Regular Languages and Regular Grammars.	12
III	Derivation Trees and Ambiguity, Simplified Forms and Normal Forms. **Pushdown Automata:** Definitions and Examples, Deterministic Pushdown Automata, A PDA from a Given CFG.	12
IV	**Context-Free and Non-Context-Free Languages :**The Pumping Lemma for Context-Free Languages, Intersections and Complements of CFLs, Decision Problems Involving Context-Free Languages. **Turing Machines:** A General Model of Computation, Turing Machines as Language Acceptors, Turing Machines that compute Partial Functions, Combining Turing Machines, Multitape Turing	12

	Machines.	
V	**Recursively Enumerable Languages:** Recursively Enumerable and Recursive, Enumerating a Language, More General Grammars, Context-Sensitive Languages and the Chomsky Hierarchy, Not Every Language is Recursively Enumerable. **Undecidable Problems:** A Language That Can't Be Accepted, and a Problem That Can't Be Decided, Reductions and the Halting Problem, More Decision Problems Involving Turing Machines.	**12**

Learning Resources	
Text Books	1. Martin John "Introduction to Languages and the Theory of Computation", 3rd Edition, Tata Mc-Grew Hill.
Reference Books	1. Mishra K.L.P &Chandrasekharan N., "Theory of Computer Science", PHI. 2. Hopcroft John E. And Ullman Jeffrey D., "Introduction to Automata Theory, Languages & Computation", 5th Edition, Narosa, 2018. 3. Lewis H. R. and Papadimitrou C. H, "Elements of the theory of Computation", PHI.
Website/Link	1. https://www.slideshare.net/Shiraz316/theory-of-computation-69977770 2. https://www.slideshare.net/imamhossain75054/toc-1-introduction-to-theory-of-computation

Mappingwith ProgrammeOutcomes

	PO01	**PO02**	**PO03**	**PO04**	**PO05**
CO1	M	L	L	L	L
CO2	L	M	M	L	L
CO3	L	S	M	L	L
CO4	M	S	M	L	L
CO5	L	S	S	L	L

S–Strong, M–Medium,L–Low

SEMESTER – V

Subject Title	PRINCIPLES OF ROBOTICS	Semester	V
Subject Code	23U5AIC07	Specialization	AI
Type	Core: Theory VII	L:T:P:C	5:0:0:4

Course objective:

- Study the concepts of Artificial Intelligence
- Learn the methods of solving problems using Artificial Intelligence
- Introduce the concepts of Expert Systems and machine learning
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence

CO No.	CO Statement	Knowledge Level
CO1	After completing Unit 01, Identify problems that are amenable to solution by AI methods	K1
CO2	After completing Unit 02, Identify appropriate AI methods to solve a given problem	K1, K2
CO3	After completing Unit 03, Identify appropriate AI methods to solve a given problem	K2, K3
CO4	After completing Unit 04, Implement basic AI algorithms	K2, K4
CO5	After completing Unit 05, Design and carry out an empirical evaluation of different algorithms on a problem formalization	K1, K3, K5

Unit	Contents	No. of Hours
I	Introduction: History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. Problem Solving: Solving problems by searching –Informed search and exploration– Constraint satisfaction problems– Adversarial search, knowledge and reasoning – knowledge representation – first order logic.	12
II	Planning: Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.	12
III	Reasoning: Uncertainity – Probabilistic reasoning–Filtering and prediction– Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.	12
IV	Learning: Forms of learning – Knowledge in learning – Statistical learning methods – reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.	12
V	AI In Robotics: Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement,	12

	Ethics and risks of artificial intelligence.	

Learning Resources	
Text Books	3. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2018. 4. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison-Wesley, 2022.
Reference Books	4. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 2012.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	S	S	M	S
CO2	S	M	M	S	S	M	S	S	M	S
CO3	S	M	M	S	S	M	M	S	M	S
CO4	S	M	M	S	M	M	M	S	M	S
CO5	S	M	M	S	M	M	M	S	M	S

S – Strong , M – Medium, L – Low (may be avoided)

Subject Title	MACHINE LEARNING TECHNIQUES	Semester	V
Subject Code	23U5AIC08	Specialization	AI
Type	Core Theory: VIII	L:T:P:C	5:0:0:4

Course objective:

- A solid understanding of essential machine learning techniques and their applications. They will develop skills in implementing algorithms for tasks such as regression, classification, and clustering.

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	To introduce students to the basic concepts and techniques of Machine Learning.	K1
CO2	To learn Decision trees, KNN and Ensemble Techniques.	K2,K4
CO3	To implement and apply machine learning algorithms to real-world applications.	K3
CO4	To understand the problems using various machine learning techniques.	K4
CO5	To study the recent machine learning software for solving practical problems.	K4

Unit	Contents	No. of Hours
I	**THE FUNDAMENTALS OF MACHINE LEARNING:** What Is Machine Learning?-Why Use Machine Learning?-Examples of Applications- Supervised / Unsupervised Learning - Batch and Online Learning - Instance-Based Versus Model-Based Learning- Main Challenges of Machine Learning.	12
II	**SUPERVISED LEARNING :** ClassificationandRegression - Generalization,Overfitting,andUnderfitting - SupervisedMachineLearningAlgorithms: k-Nearest Neighbors - Naive Bayes Classifiers - Decision Trees - EnsemblesofDecisionTrees - **UNSUPERVISED LEARNING:** Types of Unsupervised learning - ChallengesinUnsupervisedLearning- Clustering - k-MeansClustering - AgglomerativeClustering	12
III	**GRAPHICAL MODELS** : Bayesian Networks .-. Conditional Independence - Markov Random Fields - Inference in Graphical Models -	12

	Mixture Models and EM: K-means Clustering.- K-means Clustering.	
IV	**LINEAR MODELS FOR REGRESSION:** Linear Basis Function Models - Bayesian Linear Regression - Limitations of Fixed Basis Functions - k – means Algorithm - Naïve Bayes Classification Algorithm: Bayes Rule – types of events – Algorithm – Pros & Cons – Applications.	**12**
V	**IMPLEMENTING MACHINE LEARNING ALGORITHMS**: Naive Bayes Classification Algorithm: Understanding conditional probability The Bayes Rule – types of events – Algorithm – Laplace correction – Pros & Cons – Applications - Neural Networks: Working of Neural Networks – Pros and Cons - Applications – Support Vector Machine: How does SVM work?- Advantages and Disadvantages of SVM.	**12**

Learning Resources	
Text Books	1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", AurélienGéron, O'Reilly Media, 2019. 2. "Introduction to Machine Learning with Python ",Andreas C. Müller and Sarah Guido, O'Reilly Media, 2017. 3. "Data Science and Machine Learning in R",ReemaThareja McGraw-Hill India, 2021.
Reference Books	1. Pattern Recognition and Machine Learning, Christopher M. Bishop F.R.Eng, 2016 , Springer Publisher. 2. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition.
Website/Link	1. https://www.techtarget.com/searchenterpriseai/definition/supervised-learning 2. https://keremkargin.medium.com/nlp-tokenization-stemming-lemmatization-and-part-of-speech-tagging-9088ac068768 3. https://pianalytix.com/how-machine-learning-works-in-social-media-2/

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	S
CO2	S	S	S	M
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	S	S	S

S-Strong, M- Medium, L – Low

Subject Title	FUZZY LOGIC AND NEURAL NETWORKS	Semester	V
Subject Code	23U5AIDE05	Specialization	AI
Type	Elective 03: Theory	L:T:P:C	5:0:0:4

Course objective:

1. The main objective of this course is to provide the student with the basic understanding of neural networks and fuzzy logic fundamentals,
2. Program the related algorithms and Design the required and related systems.
3. Biological motivation to design intelligent systems and control
4. Study the learning strategies of Artificial Neural networks and theirϖ training algorithms

CO No.	CO Statement	Knowledge Level
CO1	Comprehend the concepts of feed forward neural networks	K1
CO2	Analyze the various feedback networks.	K2
CO3	Understand the concept of fuzziness involved in various systems and fuzzy set theory.	K3
CO4	Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm	K4
CO5	Analyze the application of fuzzy logic control to real time systems.	K5

Unit	Contents	No. of Sessions
I	Introduction: What is Neural Network-Human Brian-Models of a Neuron – Network Architecture – Knowledge Representation – AI & Neural Networks	12
II	Learning Processes: Introduction – Error – Correction Learning – Memory–Based Learning – Hebbian Learning – Competitive learning – Boltzmann Learning - Learning with a Teacher - Learning without a Teacher - Learning Tasks	12
III	Single Layer Perceptions: Introduction –Adaptive Filtering Problem-Unconstrained Optimization Techniques-Linear Least Square Filters. Multilayer Perceptions: Introduction- Back propagation Algorithm - Back propagation and Differentiation.	12

IV	Introduction: What is Fuzzy Logic- History-Motivation-Why Using Fuzzy Logic for control. Basic Concept of Fuzzy Logic: Two Exemplary Problems-Fuzzy sets-Linguistic Variables-Fuzzy Rules	**12**
V	Fuzzy Sets: Classical sets-Fuzzy sets-Operation of fuzzy sets-Properties of Fuzzy Sets-Geometric Interpretation of fuzzy sets.	**12**

Learning Resources	
Text Books	1. Neural Network A Comprehensive Foundation- , Simon HaykinMc Master University, Hamilyon, Ontario, Canada. [UNIT – I, II & III] 2. Fuzzy Logic intelligence , Control and information- John Yen Reza Langari , Center for fuzzy Logic,Robotics, and Intelligent Systems Texas A&M University. [UNIT – IV & V]
Reference Books	1. Neural Networks and Fuzzy System-dynamical System approach to machine intelligent, Bart Kosko University of Southern California 2. LauranceFausett, Englewood cliffs, N.J., "Fundamentals of Neural Networks", PearsonEducation, New Delhi, 2018
Website /Link	1. ieeexplore.ieee.org 2. www.sciencedirect.com/

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	BIGDATA ANALYTICS	Semester	V
Subject Code	23U5AIDE06	Specialization	AI
Type	Elective 03: Theory	L:T:P:C	5:0:0:4

Course objective:

- Provide an overview of Apache Hadoop
- Work with user input to create fun and interactive programs
- Create simple games with images, animations, and audio using our custom beginner-friendly programming
- Describe the core syntax and semantics of Python programming language.

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	Understand Big Data and its analytics in the real world	K1
CO2	Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics	K2
CO3	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm	K3
CO4	Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics.	K5
CO5	Implement Big Data Activities using Hive.	K5

Unit	Contents	No. of Sessions
I	**Introduction**: Types of Digital Data: Classification of Digital Data. Introduction to Big Data: Characteristics of Data- Evolution of Big Data- Definition of Big Data- Challenges with Big Data-What is big Data? Why big Data? Traditional Business Intelligence versus Big Data-A Typical Data Warehouse Environment- A Typical Hadoop Environment..	12
II	**Big Data Analytics**: Where do we Begin? What is Big Data Analytics? What is Big Data Analytics? Classification of Analytics- Why Big Data Analytics Important? Challenges Facing Big Data-Data Science-Terminologies used in Big Data Environment-Basically Available Soft State Eventual consistency (BASE).	12
III	**The Big Data Technology Landscape: NoSQL: Hadoop** Where it is used? What is it? Types of NoSQL Databases- Why NoSQL - Advantages of NoSQL- What we miss with NoSQL? -Use of	12

	NoSQLin Industry- NoSQL Vendors- SQL vsNoSQL- NewSQL- comparision of SQL, NoSQL and NewSQL. Hadoop:Feature of Hadoop-Key Advantage of Hadoop-versions of Hadoop- Overview of Hadoop Ecosystem- Hadoop Distribution- Hadoop versus SQL- cloud Based Hadoop solution	
IV	**Introducing Hadoop**-Why Hadoop?-why not RDBMS?- RDBMS vsHadoop-Distributed Computing Challenges- History of Hadoop- Overview of Hadoop- Use Case of Hadoop- Hadoop Distribution- HDFS-Processing Data with Hadoop- Interacting with Hadoop Ecosystem.	**12**
V	**Introduction to MongoDB:** What is MongoDB? -Why MongoDB- Terms Used in RBDMS and MongoDB- Data Types in MongoDB- MongoDB Query Language.	**12**

Learning Resources	
Text Books	1. SeemaAcharya, SubhashiniChellappan, "Big Data and Analytics", Wiley Publication, 2019.
Reference Books	1. 1.Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2017. 2. 2. Tom White, "Hadoop: The Definitive Guide", Reilly Publications, 2016. 3. 3. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2019. 4. 4. Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2016.
Website/Link	1. https://www.webopedia.com/TERM/B/Big_data_analytics.html 2. https://www.simplilearn.com/data-science-vs-big-data-vs-data-analytics-article

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	ARTIFICIAL INTELIGENCE & KNOWLEDGE REPRESENTATION	Semester	V
Subject Code	23U5AIDE07	Specialization	AI
Type	Elective 04: Theory	L:T:P:C	5:0:0:4

Course objective:

1. Study the concepts of Artificial Intelligence.
2. Learn the methods of solving problems using Artificial Intelligence.
3. Learn the knowledge representation techniques, reasoning techniques and planning
4. Introduce the concepts of Expert Systems and machine learning.

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	Understand the informed and uninformed problem types and apply search strategies to solve them.	K1
CO2	Apply difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing	K2
CO3	Design and evaluate intelligent expert models for perception and prediction from intelligent environment.	K3
CO4	Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.	K5
CO5	Demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.	K5

Unit	Contents	No. of Sessions
I	Basics of Artificial Intelligence: What is Artificial Intelligence- The AI Problem- The Underlying Assumption- AI Techniques-The level of the Model-criteria for success-Defining the Problem as a State Space Search-Production System-Problem Characteristics.	12
II	Heuristic Search Techniques: Issues in Design of Search Programs-Generate and Test- Hill climbing- Best-first search- Problem Reduction-Constraint satisfaction- Mean-ends Analysis	12
III	Knowledge Representation: Representation and Mappings- Approaches to knowledge representation- Issues in Knowledge Representation - Procedural Versus Declarative Knowledge - Logic Programming -Forward Versus Backwand Reasoning-Matching,	12
IV	Symbolic and Statistical Reasoning: Introduction to Nonmonotonic Reasoning -Logics for Nommonotonic Reasoning-Implementation Issues -	12

	Probability and Bayes Theorem-Certainty Factors and Rule-based Systems-Bayesian Networks-Dempster-Shafer Theory.	
V	Game Playing, Planning, Understanding: The Minimax Search Procedure-Adding Alpha beta cut-off-Additional Refinement-Planning Overview, components of planning system-Nonlinear Planning Using Constraint Posting -Hierarchical Planning and Reactive System-What is Understanding-What Makes Understanding Hard-Understanding as Constraint Satisfaction.	**12**

Learning Resources	
Text Books	1. Elaine Rich, Kevin Knight and Shivashankar B Nair, “Artificial Intelligence”
Reference Books	1. Michael Negnevitsky, “Artificial Intelligence: A Guide to Intelligent Systems” 2. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving" 3. David L. Poole and Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents".
Website/Link	1. https://intellipaat.com/blog/tutorial/artificial-intelligence-tutorial/ 2. https://www.edureka.co/blog/knowledge-representation-in-ai/ 3. https://www.brainkart.com/article/Symbolic-Reasoning_8586/ 4. https://www.geeksforgeeks.org/game-playing-in-artificial-intelligence/ 5. https://stanford-cs221.github.io/autumn2020/

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

SubjectTitle	REINFORCEMENT LEARNING	Semester	V
SubjectCode	23U5AIDE08	Specialization	AI
Type	Elective 04: Theory	L:T:P:C	5:0:0:4

Courseobjective:

1. RL task formulation (action space, state space, environment definition)
2. Tabular based solutions (dynamic programming, Monte Carlo, temporal-difference) 1
3. Function approximation solutions (Deep Q-networks)
4. Policy gradient from basic (REINFORCE) towards advanced topics (proximal policy optimization, deep deterministic policy gradient, etc.)
5. Meta-learning 8. Multi-agent learning, partial observable environments

Course Outcome:

CONo.	COStatement	Knowledge Level
CO1	Learn how to define RL tasks and the core principles behind the RL, including policies, value functions, deriving Bellman equations.	K1
CO2	Implement in code common algorithms following code standards and libraries used in RL.	K2
CO3	Understand and work with tabular methods to solve classical control problems.	K3
CO4	Learn the policy gradient methods from vanilla to more complex cases.	K5
CO5	Recognize current advanced techniques and applications in RL.	K4

Unit	Contents	No. of Sessions
I	**Introduction:** Reinforcement learning – Examples – Elements of Reinforcement learning – Multi-armed Bandits : Action value methods – Incremental implementation – Optimistic initial values – Upper Confidence Bound Action Selection – Gradient Bandit Algorithm.	12
II	**Markov Decision Processes:** The Agent–Environment Interface - Goals and Rewards - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - Optimal Policies and Optimal Value Functions - Optimality and Approximation	12
III	**Dynamic Programming:** Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration - Asynchronous Dynamic Programming - Generalized Policy Iteration – Efficiency of Dynamic Programming	12

IV	**Monte Carlo Methods:** Monte Carlo Prediction – Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Incremental Implementation - Temporal-Difference Learning : TD Prediction - Advantages of TD Prediction Methods	**12**
V	**Planning and Learning with Tabular Methods:** Models and Planning - Dyna: Integrated Planning, Acting, and Learning - Prioritized Sweeping - Expected vs. Sample Updates - Trajectory Sampling - Real-time Dynamic Programming - Planning at Decision Time - Heuristic Search - Rollout Algorithms - Monte Carlo Tree Search	**12**

LearningResources	
TextBooks	1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019 2. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012).
Reference Books	1. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018). 2. David Silver's course on Reinforcement Learning
Website/Link	1. https://in.mathworks.com/campaigns/offers/guide-to-understanding-reinforcement-learning 2. https://www.javatpoint.com/reinforcement-learning 3. https://www.geeksforgeeks.org/what-is-reinforcement-learning/

MappingwithProgrammeOutcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	M
CO2	S	M	S	S
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	S	M	L

S-Strong,M-Medium,L–Low

Subject Title	ROBOTICS LAB	Semester	V
Subject Code	23U5AICP05	Specialization	AI
Type	Core Practical: V	L:T:P:C	0:0:4:4

Course objective:

- Study the concepts of Artificial Intelligence
- Learn the methods of solving problems using Artificial Intelligence
- Introduce the concepts of Expert Systems and machine learning
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence

CO No.	CO Statement	Knowledge Level
CO1	Identify problems that are amenable to solution by AI methods	K1
CO2	Identify appropriate AI methods to solve a given problem	K1, K2
CO3	Identify appropriate AI methods to solve a given problem	K2, K3
CO4	Implement basic AI algorithms	K2, K4
CO5	Design and carry out an empirical evaluation of different algorithms on a problem formalization	K1, K3, K5

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for pick and place
5. Robot programming and simulation for colour identification
6. Robot programming and simulation for Shape identification
7. Robot programming and simulation for machining (cutting, welding)
8. Robot programming and simulation for writing practice
9. Robot programming and simulation for any industrial process (Packaging, Assembly)
10. Robot programming and simulation for multi process.

Subject Title	MACHINE LEARNING TECHNIQUES LAB	Semester	V
Subject Code	23U5AICP06	Specialization	NA
Type	Core: Practical - VI	L:T:P:C	0:0:4:4

Course objective:

- A solid understanding of essential machine learning techniques and their applications. They will develop skills in implementing algorithms for tasks such as regression, classification, and clustering.

List of Experiments

1. Familiarizing with Anaconda and Jupyter for importing modules and dependencies for ML.
2. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of kmeans clustering with 3 means (i.e., 3 centroids) periments

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
5. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
6. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
7. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
8. Write a Python program to implement Simple Linear Regression and plot the graph.
9. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
10. Using Weka tool for SVM classification for chosen domain application.

SEMESTER – VI

SubjectTitle	NATURAL LANGUAGE PROCESSING	Semester	VI
SubjectCode	23U6AIC09	Specialization	AI
Type	Core XI: Theory	L:T:P:C	5:0:0:4

Courseobjective:

- The fundamental concepts and techniques of Natural Language Processing
- Identify and apply the various NLP techniques to solve real-time problems.
- To apply the concept of data structures to various real-time applications.

Courseoutcome:

CO No.	COStatement	Knowledge Level
CO1	Understand the fundamental concepts of NLP.	K1
CO2	Demonstrate the NLP Computational Phonology and Text-to-Speech.	K2
CO3	Differentiate the levels of classes and speech for language processing.	K3
CO4	Apply the levels of semantics for language processing.	K3
CO5	Determine the pragmatics of Natural Language Processing	K3

Unit	Contents	No. of Hours
I	**Words:Regular Expressions and Automata:** Regular Expressions, Basic Regular Expression Patterns, Disjunction, Grouping, and Precedence, A simple example, Advanced Operators, Regular Expression Substitution, Memory, and ELIZA. **Finite-State Automata:** Using an FSA to Recognize Sheeptalk, Formal Languages, Nondeterministic FSAs, Using an NFSA to accept strings, Recognition as Search, Relating Deterministic and Non-deterministic Automata, Regular Languages and FSAs.	**12**
II	**Computational Phonology and Text-to-Speech:** Speech Sounds and Phonetic Transcription, The Vocal Organs, Consonants: Place of Articulation, Consonants: Manner of Articulation, Vowels, The Phoneme and Phonological Rules, Phonological Rules and Transducers, Advanced Issues in Computational Phonology.	**12**
III	**Syntax: Word Classes and Part-of-Speech Tagging :**English Word Classes, Tagsets for English, Part of Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging.	**12**
IV	**Context-Free Grammars for English:** Constituency, Context-Free	**12**

	Rules and Trees, Sentence-Level Constructions, The Noun Phrase, Coordination, Agreement, The Verb Phrase and Subcategorization, Auxiliaries, Spoken Language Syntax. **Semantics: Semantic Analysis:** Syntax-Driven Semantic Analysis, Attachments for a Fragment of English, Integrating Semantic Analysis into the Earley Parser, Idioms and Compositionality, Robust Semantic Analysis.	
V	**Lexical Semantics:** Relations Among Lexemes and Their Senses, WordNet: A Database of Lexical Relations, The Internal Structure of Words, Creativity and the Lexicon. **Pragmatics: Discourse:** Reference Resolution, Text Coherence, Discourse Structure, Psycholinguistic Studies of Reference and Coherence.	**12**

Learning Resources	
Text Books	1. Daniel J and James H. Martin, "Speech and language processing – An introduction to natural language processing, computational Linguistics & Speech Recognition" 4TH Edition, PHl, 2016.
ReferenceBooks	1. Lan H Written and Elbef. MarkA.Hall, "Data mining: Practical Machine Learning Tools and Techniques", (3rdEdn.)Morgan Kaufmann, 2018.
Website/Link	1. https://www.geeksforgeeks.org/natural-language-processing-overview/ 2. https://www.deeplearning.ai/resources/natural-language-processing/

Mappingwith ProgrammeOutcomes

	PO01	**PO02**	**PO03**	**PO04**	**PO05**
CO1	S	M	S	M	L
CO2	L	S	L	S	S
CO3	M	M	M	M	M
CO4	M	S	M	S	S
CO5	L	M	M	M	S

S–Strong, M–Medium,L–Low

Subject Title	DATA VISUALIZATION	Semester	VI
Subject Code	23U6AIC10	Specialization	AI
Type	Core: Theory X	L:T:P:C	5:0:0:4

Course objective:

- The main goal of data visualization is to make it easier to identify patterns, trends and outliers inlargedatasets.
- Thetermisoftenusedinterchangeablywithothers,includinginformationgraphics,informat ionvisualization and statistical graph

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	Designandcreatedatavisualizations.	K1
CO2	Conductexploratorydataanalysisusingvisualization.	K2, K4
CO3	Craftvisualpresentationsof dataforeffectivecommunication.	K3
CO4	Useknowledgeof perceptionandcognitiontoevaluatevisualizationdesignalternatives.	K4
CO5	Datavisualizationallowsbusinessuserstogaininsightintotheirvastamountsof data.	K4

Unit	Contents	No. of Hours
I	**IntroductiontoDataVisualization:** WhyDataVisualization?WhatCanYouBelieve?SomePicturesAreMorePersuasiv e,DifferentShades of theTruthin visualization,StartSketchingYourDataStory, RecommendedToolsfordatavisualizationanddemonstrationofTools.	12
II	**DataManagementfordatavisualization:** Select Your Spreadsheet Tools, Download to CSV or ODS Format, Make a Copy of a Google Sheet, ShareYour Google Sheets, Upload and Convert to Google Sheets, Geocode Addresses in Google Sheets, CollectDatawithGoogleForms,SortandFilterData,CalculatewithFormulas,Summ arizeDatawithPivotTables MatchColumnswithVLOOKUP, SpreadsheetVersusRelationalDatabase	12
III	**Datasources andDataprocessingfor datavisualization:** Open Data Repositories, Source Your Data, Recognize Bad Data Smart Cleanup with Google Sheets, FindandReplacewithBlank,TransposeRows andColumns,SplitDataintoSeparateColumns,CombineData intoOneColumn,souring dataandprocessingdataforBankingdata,RetaildataandHealthcaredata.	12

IV	AdvancedDataprocessingandBasic ChartingExtract Tables from PDFs with Tabula, Clean Data with Open Refine, Set Up Open Refine, Load Data andStart a New Project, Convert Dollar Amounts from Text to Numbers, Cluster Similar Spellings PreciselyDescribeComparisons, NormalizeYourDataChartDesignPrinciples,DeconstructaChart,SomeRules AreMoreImportantThanOthers,Chart Aesthetics,GoogleSheetsCharts,BarandColumn Charts	**12**
V	InteractivityChartingandStoryboardVisualization Histograms, Pie, Line, and Area Charts, Data wrapper Charts, Annotated Charts, Range Charts, ScatterBubble Charts. Map Design Principles: Deconstructing a Map, Clarify Point-Versus-Polygon Data, Map OneVariable, Not Two, Choose Smaller Geographies for Choropleth Maps Storyboard: Build a Narrative on aStoryboard,DrawAttentiontoMeaning,AcknowledgeSources and Uncertainty Decide onYour Data StoryFormat	**12**

Learning Resources	
Text Books	1. HandsOnDataVisualizationby JackDoughertyIlyaIlyankou
Reference Books	1. The Truthful Art Data Charts and Maps for Communication– Pearson Education 2016 2. FewStephenShowMetheNumbersDesigningTablesandGraphstoEnlighten Second editionBurlingam CAAnalytics Press,2012
Web / Link	1. https://www.analyticsvidhya.com/blog/2021/06/must.known-data- 2. visyalisation.techniques-for-data-science/

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	S	S	M	S
CO2	S	M	M	S	S	M	S	S	M	S
CO3	S	M	M	S	S	M	M	S	M	S
CO4	S	M	M	S	M	M	M	S	M	S
CO5	S	M	M	S	M	M	M	S	M	S

S – Strong , M – Medium, L – Low (may be avoided)

Subject Title	GENERATIVE AI	Semester	VI
Subject Code	23U6AIDE09	Specialization	NA
Type	Elective: 05 - Theory	L:T:P:C	5:0:0:4

Course objective:

- To explain problem solving and reasoning strategies in AI systems
- To enable students to analyze a problem so that appropriate problem solving techniques may be applied
- To recognize the importance of dealing with the cause of a problem, rather than just dealing with the effect of a problem
- To learn how to generate alternative solutions, using creative thinking and brainstorming
- To learn the different stages of the decision making process and understand the importance of each stage in ensuring effective decisions are made

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	Identify problems where artificial intelligence techniques are applicable	K1
CO2	Apply selected basic AI techniques; judge applicability of more advanced techniques	K2
CO3	Apply AI is also expected to transform business operations and contribute to global economic activity	K3
CO4	Develop a technology that will capacitate computer systems to perform independently of human intervention and intelligently.	K3
CO5	Develop systems that can analyze large datasets, identify patterns, and make data-driven decisions.	K3

Unit	Contents	No. of Sessions
I	**General introduction of AI**: What is AI?, The foundations of AI, The history of AI, The state of the art. Intelligent agents: Agents and environments, Good behavior: The concept of reality, The nature of environments, The structure of agents, AI applications.	12
II	**Solving problems by searching:** Problem-solving agents, Example problems, Searching for solutions, Uninformed search strategies, Avoiding repeated states, Searching with partial information. Informed search and exploration: Informed search strategies, Heuristic functions,	12

	Local search algorithms and optimization problems, Local search in continuous spaces.	
III	**Constraint satisfaction problems**: Backtracking search for CSPs, Local search for constraint satisfaction problems, The structure of problems. Adversarial search: Games, Optimal decisions in games, Alpha-beta pruning, Imperfect realtime decisions, Games that include an element of chance, State-of-the-art game programs	**12**
IV	**Formalized symbolic logics:** Introduction, Syntax and semantics for propositional logic, Syntax and semantics for first order propositional logic, Properties of WFFS, Connection to clausal (w.e.f 2015-2016) form, Inference rules, The resolution principle, Non-deductive inference methods, Representations using rules.	**12**
V	**The Planning problem:** Planning with state-space search, Partial-order planning, Planning graphs, Planning with propositional logic, Analysis of planning approaches. Planning and acting in the real world: Time, schedules, and resources, Hierarchical task network planning, planning and acting in nondeterministic domains, Conditional planning, Execution monitoring and replanning, Continuous planning.	**12**

Learning Resources	
Text Books	1. D. W. Patterson: Introduction to AI & Expert System, PHI. 2. S. Russell and P. Norvig. AI: A Modern Approach, 2nd Ed., McGraw-Hill, 2017.
Reference Books	1. J. Siekmann, R. Goebel, and W. Wahlster: Problem Solving Methods, Springer, 2015. 2. N.J.Nilsson: Principles of Artificial Intelligence, Narosa Publications.
Website /Link	1. http://repo.darmajaya.ac.id/5328/1/Principles%20of%20Artificial%20Intelligence%20%28%20PDFDrive%20%29.pdf

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	M
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	INTELLIGENT ROBOTICS AND DRONE TECHNOLOGY	Semester	VI
Subject Code	23U6AIDE10	Specialization	NA
Type	Elective 05: Theory	L:T:P:C	5:0:0:4

Course Objective:

1. Explain the space of design for robotic communication, safety, state estimation and Control.
2. Apply the knowledge to construct programs for communication, safety, state estimation and control.
3. Apply the knowledge for Robotics
4. Build, program, and operate an autonomous robot drone.
5. Hand on experience on design, fabrication and flying of UAV.

Course Outcome:

CO No.	CO Statement	Knowledge Level
CO1	StudentsunderstandaboutRobotics	K1
CO2	The concept of robots, robot Anatomy, Robot behavior.	K2
CO3	Understand the applications of robots in real life applications.	K3
CO4	Explain the concepts of Drone and Applications of drones, Propulsion.	K5
CO5	Describe the parts and functions of UAV & Indian Aviation regulations of UAV.	K4

Unit	Contents	No. of Sessions
I	History of robots, Classification of robots, Present status and future trends. Basic components ofrobotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom.Mechanisms and transmission, Design and control issues, Manipulation and control, Sensors andvision,Programmingrobot,Futureaspect.	12
II	**DrivesystemsandSensors:** Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors,Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors,Pressuresensors.	12
III	**KinematicsandDynamicsofRobots:** 2D,3D Transformation,Scaling,Rotation,Translation,Homogeneous coordinates,multipletransformation, Simple problems. Matrix representation, Forward and Reverse Kinematics OfThree Degree of Freedom, Homogeneous	12

	Transformations, Inverse kinematics of Robot, RobotArmdynamics,D-Hrepresentationofrobots,BasicsofTrajectoryPlanning.	
IV	**Basics of Drone:** Different types of flight vehicles - Components and functions ofan airplane - Forces acting on Airplane - Physical properties and structure of the atmosphere ,DifferencebetweenaircraftandUAV,PartsandfunctionsofFixed,Rotorcraftandflappingwing UAV–variousHistoryofUAV's.	**12**
V	**TypesandApplicationsofDrones:**TypesofDrones,ApplicationsandUses.Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles and theirapplications–Defense,Civil,Environmentalmonitoring(physical,chemicalandbiological	**12**

Learning Resources	
Text Books	1. MikellPGroover,NicholasG.Odrey,MitchelWeiss, RogerNNagel,AshishDutta,"IndustrialRobotics,Technologyprogrammingand Applications",McGrawHill,2017. 2. Craig.J. J."IntroductiontoRobotics-mechanicsandcontrol",Addison-Wesley,2016. 3. Andey Lennon " Basics of R/C model Aircraft design" Model airplane news publication
Reference Books	1. S.R.Deb,"RoboticsTechnologyandflexibleautomation",TataMcGraw-HillEducation.,2019. 2. RichardD.Klafter,Thomas.A,ChriElewski,MichaelNegin,"RoboticsEngineeringanIntegratedApproach",PHILearning.,2019. 3. FrancisN.Nagy,AndresSiegler,"EngineeringfoundationofRobotics",Prentice HallInc.,. 4. P.A.JanakiRaman,"RoboticsandImageProcessinganIntroduction",TataMcGrawHillPublishingcompanyLtd., 5. CarlD.CraneandJosephDuffy,"KinematicAnalysisofRobotmanipulators",CambridgeUniversitypress,2018.
Website /Link	1. https://www.intechopen.com/chapters/1154922

Mapping with Programme Outcomes

	PO01	PO02	PO03	PO04
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

Subject Title	INFORMATION RETRIEVAL TECHNIQUES	Semester	VI
Subject Code	23U6AIDE11	Specialization	NA
Type	Elective 06: Theory	L:T:P:C	4:0:0:4

Course objective:

- To understand the basics of Information Retrieval.
- To understand machine learning techniques for text classification and clustering.
- To understand various search engine system operations.
- To learn different techniques of recommender system.

CO No.	CO Statement	Knowledge Level
CO1	Use an open source search engine framework and explore its capabilities	K1
CO2	Apply appropriate method of classification or clustering.	K2,K4
CO3	Design and implement innovative features in a search engine.	K3
CO4	Design and implement a recommender system.	K4
CO5	To analyze the models to rectify the drawbacks.	K4

Unit	Contents	No. of Sessions
I	Information Retrieval – Early Developments – The IR Problem – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes – The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today	12
II	Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation	12
III	A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching Hadoop:Feature of Hadoop-Key Advantage of Hadoop-versions of Hadoop- Overview of Hadoop Ecosystem- Hadoop Distribution- Hadoop versus SQL- cloud	12

	Based Hadoop solution	
IV	The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations — Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.	**12**
V	Recommender Systems Functions – Data and Knowledge Sources – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighborhood models.	**12**

Learning Resources	
Text Books	1. Ricardo Baeza-Yates and BerthierRibeiro-Neto, ―Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2017. 2. Ricci, F, Rokach, L. Shapira, B.Kantor, ―Recommender Systems Handbook, First Edition, 2018.
Reference Books	1. C. Manning, P. Raghavan, and H. Schütze, ―Introduction to Information Retrieval, Cambridge University Press, 2018. 2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, ―Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2016.
Website/Link	1. https://prathyusha.edu.in/wp-content/uploads/2022/12/cse-CS8080-IRT.pdf 2. https://www.scribd.com/document/649566655/5-Unit-Notes

Mapping with Programme Outcomes

	PO01	**PO02**	**PO03**	**PO04**
CO1	S	S	S	-
CO2	S	M	M	S
CO3	S	L	L	M
CO4	M	S	M	S
CO5	S	L	S	S

S-Strong , M- Medium , L – Low

SubjectTitle	OPTIMIZATION TECHNIQUES	Semester	VI
SubjectCode	23U6AIDE12	Specialization	AI
Type	Elective 06: Theory	L:T:P:C	5:0:0:4

Courseobjective:

- Equip students with the knowledge and skills to formulate, solve, and apply optimization techniques to improve decision-making and efficiency in various real-world scenarios.

CourseOutcome:

CO No.	COStatement	Knowledge Level
CO1	To understand introduces students to the fundamental principles and techniques	K1
CO2	It Focus both theoretical foundations and practical applications	K2
CO3	Its include linear programming, nonlinear optimization, integer programming, dynamic programming, and heuristic methods.	K2
CO4	Emphasis is placed on understanding optimization models, algorithms.	K4
CO5	Its implementation of models and their algorithms.	K5

Unit	Contents	No. of Sessions
I	**Introduction:**The Origins of Operations Research -The Nature of Operations Research - The Impact of Operations Research - Algorithms and OR Courseware- Overview of the Operations Research Modeling Approach- Introduction to Linear Programming.	12
II	Solving Linear Programming Problems: The Simplex Method- The Theory of the Simplex Method- Duality Theory and Sensitivity Analysis.	12
III	Other Algorithms for Linear Programming- The Dual Simplex Method - Parametric Linear Programming- The Upper Bound Technique -An Interior-Point Algorithm.- The Transportation and Assignment Problems: The Transportation Problem - A Streamlined Simplex Method for the Transportation Problem - The Assignment Problem - A Special Algorithm for the Assignment Problem.	12
IV	Network Optimization Models: Prototype Example - The Terminology of Networks - The Shortest-Path Problem - The Minimum Spanning Tree Problem -The Maximum Flow Problem - The Minimum Cost Flow Problem -The Network Simplex Method - A Network Model for Optimizing a Project's Time-Cost Trade-Off- Dynamic Programming.	12

V	Integer Programming: Prototype Example - Some BIP Applications - Innovative Uses of Binary Variables in Model Formulation - Some Formulation Examples - Some Perspectives on Solving Integer Programming Problems - The Branch-and-Bound Technique and Its Application to Binary Integer Programming - A Branch-and-Bound Algorithm for Mixed Integer Programming - The Branch-and-Cut Approach to Solving BIP Problems - The Incorporation of Constraint Programming .	**12**

Learning Resources	
Text Books	1. "Introduction to Operations Research" by Hillier and Lieberman (McGraw-Hill)Prentice Hall of India, ninth edition
Reference Books	1. Boyd and Vandenberghe, “Convex Optimization", Cambridge University Press 2. Bazaraa, Sherali, and Shetty, "Nonlinear Programming: Theory and Algorithms" Wiley Publication. 3. Talbi, “Metaheuristics: From Design to Implementation" Wiley Publication.
Website /Link	1. https://optimization-online.org/ 2. https://scholar.google.com/

Mappingwith ProgrammeOutcomes

	PO01	**PO02**	**PO03**	**PO04**	**PO05**
CO1	M	M	S	S	M
CO2	L	L	S	S	M
CO3	S	S	S	S	L
CO4	S	S	S	M	L
CO5	L	L	S	M	L

S–Strong, M–Medium,L–Low

SubjectTitle	NATURAL LANGUAGE PROCESSING LAB	Semester	VI
SubjectCode	23U6AICP07	Specialization	AI
Type	Core VII: Practical	L:T:P:C	0:0:4:3

Courseobjective:

- The fundamental concepts and techniques of Natural Language Processing
- Identify and apply the various NLP techniques to solve real-time problems.
- To apply the concept of data structures to various real-time applications.

List of Experiments:

1. Implement word similarity
2. Write an FSA for time-of-day expressions like eleven o'clock, twelve thirty, midnight, or a quarter to ten and others.
3. Write a transducer(s) for the K insertion spelling rule in English.
4. Implement simple problems related to word disambiguation
5. Demonstration of Part of Speech Tagging.
6. Convert the text into speech
7. Design a Semantic Analyzer.
8. Find some articles about business, sports, or politics from your daily newspaper. Identify as many lexical metaphors and metonymies as you can in these articles. How many of these uses have reasonably close entries in either WordNet or your favorite dictionary?
9. Implement a small air-travel help system. Your system should get constraints from the user about a particular flight that they want to take, expressed in natural language, and display possible flights on a screen.
10. Write a finite-state automaton for a dialogue manager for checking your bank balance and withdrawing money at an automated teller machine.

SubjectTitle	PROJECT WORK	Semester	VI
SubjectCode	23U6AICPR01	Specialization	AI
Type	Core I: Project	L:T:P:C	0:0:4:4

Course Objective

- To acquire knowledge in developing skills.
- To implement real time problems using any Programming language.

Course Outcomes

CO No.	CO Statement	Knowledge Level
CO1	Designing an application for the given problem.	K1
CO2	Writing coding for the designed application.	K2,K4
CO3	Acquiring knowledge in industry level developing skills.	K3
CO4	Getting familiar with project platform.	K4
CO5	Developing skills in Documentation and Presentation skills.	K4

Project Work Pattern

First Review: (20Marks)

1. Project Title
2. Project Platform (Language/Package Selected)
3. Confirmation Letter (from Company/Industry)
4. Details of Internal Guide with Designation & Qualification (in the company / Industry / Organization).
5. Presentation

Second Review: (20 Marks)

1. Work Observation
2. Modules in Project (Design Screens Sample)
3. DFD/ERD/System Flow Diagram (Whichever Applicable)
4. Estimated Time of Completion
5. Completed Work in the form of Percentage Analysis
6. PowerPoint Presentation.

Final Review: (60 Marks)

1. Documentation
2. Screens Shots
3. DFD/ERD/System Flow Diagram (Whichever Applicable)
4. Final Project Report(with executable format including complete source code)

The Passing minimum shall be 40% out of 60 marks (24Marks)