



JOY UNIVERSITY

Established vide Tamil Nadu State Pvt. Universities Act 2019



SCHOOL OF COMPUTATIONAL SCIENCE

Outcome Based Curriculum Framework with CBCS

for

BACHELOR OF COMPUTER APPLICATION

(ARTIFICIAL INTELLIGENCE)

(BCA Artificial Intelligence)

Students admitted from 2025 -26 onwards



VISION

To create and nurture a multidisciplinary global university with highest academics, research and ethical standards in a creative and innovative environment.

MISSION

To be a premier University of choice for all stakeholders and contribute for academic demographic dividend. To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.

QUALITY OBJECTIVES

- To disseminate knowledge with skills through teaching, training, seminars, workshops, conferences and symposia in Engineering and Technology, Art and Design, Management and Commerce, Allied Health Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences, Law and Agricultural Sciences to enable students to meet the current needs and trends of industries, business and society.
- To provide technical and scientific solutions to real time problems posed by industries, business and society in all Schools of Joy University.
- To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.
- To promote the spirit of entrepreneurship in the young generation to help and create more career opportunities in the society by incubating a nurturing technology product idea backed by Technology Business Incubation.
- To identify and nurture leadership and innovate skills in students to become future leaders to enrich society.
- To develop collaborations and partnerships with International global and reputed Universities, research establishments, Government and NGO's, industries and businesses. To support both faculties and students for international exposure.

SCHOOL OF COMPUTATIONAL INTELLIGENCE

VISION

The SOCI envisions a 'cooperatively competitive' academic environment in the thematic areas of the school and relevant research backed by quality education to churn out graduates with professional acumen, exceptional leadership and a humane heart to meet both national and global needs.

MISSION

The SOCI offers a value-based, technology-oriented education striving to achieve high levels of academic excellence, intellectually competence and exemplary values. The tri-value system of our school is designed to deliver education through three interconnected values: **Learning, Transmutation and Transformation.**

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

- PEO1:** Demonstrate analytical and design skills including the ability to generate creative solutions and foster team-oriented professionalism through effective communication in their careers.
- PEO2:** Expertise in successful careers based on their understanding of formal and practical methods of application development using the concept of computer programming languages and design principles in national and international level.
- PEO3:** Pursue advanced education, research and development moreover other creative and innovative efforts in science and technology, as well as other professional careers.
- PEO4:** Implement their exhibiting critical thinking and problem-solving skills in professional practices or tackle social, technical and business challenges.
- PEO5:** Illustrate effective work conventionalities and be able to adapt as well as accept to the challenges of a dynamic job environment.

PROGRAM OUTCOMES (PO)

- P01:** To identify, formulate, review literature and analyze complex engineering problems reaching substantiated conclusions.
- P02:** To design solutions for designing system components or processes that meet the specified needs with appropriate consideration for cultural, societal and environmental considerations.
- P03:** To use research-based knowledge for analysis and interpretation of data and synthesis of the information to provide valid conclusions.
- P04:** To create, select and apply appropriate techniques, resources, and modern automation tools.
- P05:** To apply the knowledge of engineering specialization to solve complex problems.
- P06:** To convert the real-world problems into computational problem to solve them by using various computational and problem-solving skills.

PROGRAM SPECIFIC OUTCOME (PSO)

- PSO1:** To develop programming skills, networking skills, learn applications, packages, programming languages and modern techniques of Computer Science with Artificial Intelligence
- PSO2:** To understand the structure and development methodologies of software systems.
- PSO3:** To implement the analytical skills, decision making and problem-solving skill in the field of computational studies.

Summary of Credits/Program and Contact Hrs./Week

Semester	I	II	III	IV	V	VI	Total
Credits	16	21	19	23	26	23	128
Contact Hrs./Week	20	25	23	24	26	10	128

SEMESTER WISE CREDIT STRUCTURE

Sl. No.	Category of Courses	1 st Year		2 nd Year		3 rd Year		Total
		Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	
		1.	Departmental Core	08	11	19	18	
2.	Program Specific Electives (PSE)	-	-	-	03	03	-	06
4.	Applied Sciences	04	07	-	-	-	-	11
5.	Internships/ Field Visits	-	-	-	02	02	-	04
6.	Project	-	-	-	-	-	15	15
7.	Skill Enhancement Course	-	01	-	-	-	-	01
8.	Ability Enhancement Courses (AECC)	03	-	-	-	-	-	03
9.	Value-Added Course	01	02	-	-	-	-	03
10.	Open-Elective					03		03
Total		16	21	19	23	26	23	128

Bachelor of Computer Application – Artificial Intelligence

Semester – I							
Sl. No.	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits
1.	25BCAI111	Core Course Fundamentals of Computing	3	0	0	3	3
2.	25BCAI112	Core Course Introduction to Programming	3	0	0	3	3
3.	25BCAI113	Applied Science Mathematics I	3	1	0	4	4
4.	25AEEN911	Ability Enhancement Compulsory Course (AECC) Effective Communication	3	0	0	3	3
5.	25BCAI911	Value-Added Course Performing Arts/Sports (Graded)	3	0	0	3	1
6.	25BCAI211	Core Course Fundamentals of Computing Lab	0	0	2	2	1
7.	25BCAI212	Core Course Introduction to Programming Lab	0	0	2	2	1
TOTAL			15	1	4	20	16

Semester - II							
Sl. No.	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BCAI121	Core Course Python Programming	3	0	0	3	3
2.	25BCAI122	Applied Science Probability, Statistics and Stochastic Processes	3	0	0	3	3
3.	25BCAI123	Applied Science Mathematics II	3	1	0	4	4
4.	25BCAI124	Core Course Office Automation Tools	3	0	0	3	3
5.	25BCAI125	Core Course Discrete Structures for Computer Science	3	0	0	3	3
6.	25EVST921	Value Added Course Environmental Science	2	0	0	2	2
7.	25BCAI221	Core Course Python Programming Lab	0	0	2	2	1
8.	25BCAI222	Core Course Office Automation Tools Lab	0	0	2	2	1
9.	25BCAI223	Skill Enhancement Course Extended Reality and its applications (from TANSAM)	0	1	2	3	1
TOTAL			17	2	6	25	21

Semester III

Sl. No.	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BCAI131	Core Course Artificial Intelligence	3	0	0	3	3
2.	25BCAI132	Core Course Computer Networks	3	0	0	3	3
3.	25BCAI133	Core Course Digital Design	3	0	0	3	3
4.	25BCAI134	Core Course Data Structure and Algorithms	3	0	0	3	3
5.	25BCAI135	Core Course Object Oriented Programming with Java	3	0	0	3	3
6.	25BCAI231	Core Course Digital Design Lab	0	0	2	2	1
7.	25BCAI232	Core Course Data Structure and Algorithms Lab	0	0	2	2	1
8.	25BCAI233	Core Course Object Oriented Programming with Java Lab	0	0	2	2	1
9.	25BCAI234	Core Course Computer Networks Lab	0	0	2	2	1
TOTAL			15	0	8	23	19

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BCAI141	Core Course Machine Learning	3	0	0	3	3
2.	25BCAI142	Core Course Database Management Systems	3	0	0	3	3
3.	25BCAI143	Core Course Computer organization and Architecture	3	0	0	3	3
4.	25BCAI144	Core Course Operating Systems	3	0	0	3	3
5.	25BCAI145	Core Course Cryptography and Network Security	3	0	0	3	3
6.	25BCAI241	Core Course Machine Learning Lab	0	0	2	2	1
7.	25BCAI242	Core Course Database Management Systems Lab	0	0	2	2	1
8.	25BCAI243	Core Course Cryptography and Network Security lab	0	0	2	2	1
9.	25BCAI341 25BCAI342 25BCAI343	Program Specific Elective I: Full Stack Development Edge AI and Tiny ML Social Network Analysis	3	0	0	3	3
10.	25BCAI441	Internship Industrial Internship	0	0	0	0	2
		TOTAL	18	0	4	24	23

Semester V							
Sl. No.	Course Code	Course Title	L	T	P	Contac Hrs /Wk	Credits
1.	25BCAI151	Core Course Deep Learning	3	0	0	3	3
2.	25BCAI152	Core Course Web Technology	3	0	0	3	3
3.	25BCAI153	Core Course Theory of computation	3	1	0	4	4
4.	25BCAI154	Core Course Software Engineering	3	0	0	3	3
5.	25BCAI155	Core Course Internet of Things	3	0	0	3	3
6.	25BCAI251	Core Course Deep Learning Lab	0	0	2	2	1
7.	25BCAI252	Core Course Web Technology Lab	0	0	2	2	1
8.	25BCAI351 25BCAI352 25BCAI353 25BCAI354	Program Specific Elective Cloud Security Cloud Computing Fuzzy logic and Applications Natural Language Processing	3	0	0	3	3
9.	25BCAI451	Internship Industrial Internship	0	0	0	0	2
10.	25BCAI051 25BCAI052 25BCAI053	Open Electives Artificial Intelligence Python Programming Computed Networks	3	0	0	3	3
		TOTAL	21	1	4	26	26

Semester VI

Sl. No.	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits
1.	25BCAI161	Core Course Predictive Analysis	3	0	0	3	3
2.	25BCAI162	Core Course Compiler Design	3	0	0	3	3
3.	25BCAI261	Core Course Predictive Analysis Lab	0	0	2	2	1
4.	25BCAI262	Core Course Compiler Design Lab	0	0	2	2	1
5.	25BCAI561	Project Capstone Project	0	0	0	0	15
		TOTAL	6	0	4	10	23

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI111	Number of Hours/Week	45/3			
Semester	I	Max. Marks	100			
Course Category	Core	Credits	3			
Course Title	FUNDAMENTALS OF COMPUTING			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To have a comprehensive understanding of a foundational understanding of computer systems.
- To learn about various number systems including decimal, binary, octal, and hexadecimal
- To develop a comprehensive grasp of how computers function, the types of software used and the significance of networking in today's digital world.

UNIT	TOPICS	HOURS
I	<p>Introduction to Computer: Evolution of Computers, Generations of Computers, Classification of Computers, The Computer System, Computing Concepts, Applications of Computers.</p> <p>Memory and storage systems: Computer Software and Hardware components and its requirements- Storage Devices,</p> <p>Computer Viruses: Types Of Viruses – Spreading of Virus, Prevention of Computer Virus, Virus Detection, Computer Security, Maintenance, Desktop functions, Dialog boxes, Single Document Interface (SDI), Multiple Document Interface (MDI), Windows Controls, Main Menu Display, Categories of Menus, Main and Context Sensitive Menus, Booting/Shutting Down.</p>	9
II	<p>Microsoft software: MS DOS, MS Word System, MS Excel System, MS Power Point System, MS Access System, MS Publisher.</p> <p>Number System: Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System, BCD, XS,3, Gray Code, Alphanumeric Codes,(ASCII, EBCDIC).</p>	9
III	<p>Computer Software: Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, System Management Programs, Standard Application Programs, Unique Application Programs, Problem Solving, Structuring the Logic.</p>	9
IV	<p>Memory management: Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems.</p>	9
V	<p>The Internet And World Wide Web : History of the Internet-The Internet Applications- Understanding World Wide Web-Web Browsers-Browsing the Internet-Using a Search Engine-Email Service-Protocols used in the Internet.</p> <p>Data Communications and Networks: Introduction-Data Communication Using Modem-Computer Networks-Network Topologies-Network Protocols and Software-Applications of Network.</p>	9

Text Books:

1. Fundamentals of Computers, E. Balagurusamy, Tata McGraw Hill Education Private Limited, 2009.

Reference Books:

1. Introduction to Computer Fundamentals, Bright Siaw Afriyie, Second edition, Trafford Publishing, Canada, 2003-2006.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01	Understand the basic concepts of computers.	K2
C02	Analyze the basics of number systems.	K4
C03	Apply system development programs to create and manage simple software projects.	K3
C04	Analyze the performance of different memory management techniques and their impact on system efficiency.	K4
C05	Evaluate the knowledge of Internet history to understand current Internet technologies and to solve problems in communication and information access.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	0	3	0	0	2	3	1
C02	3	3	3	2	3	2	2	2	1
C03	3	3	2	3	2	2	3	2	3
C04	3	2	2	3	1	1	3	1	1
C05	3	2	2	2	1	3	2	1	1

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI112	Number of Hours/Week	3			
Semester	I	Max. Marks	100			
Course Category	Core	Credits	3			
Course Title	INTRODUCTION TO PROGRAMMING			L	T	P
			3	0	0	
COURSE OBJECTIVES						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language. • To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language • Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management. 						
UNIT	TOPICS				HOURS	
I	Introduction to programming Algorithm, Formalism, Flow chart, Assembly language, Introduction to program, Program components, structure, Execution path, Programming paradigms introduction, Syntax and Semantics				9	
II	Introduction to C language History of C, Prerequisites of C, Features and its applications, Structure of C, Preprocessor directives, Data types and constants, variables and its types, Tokens, Identifiers and format specifiers, Operators and Enums, Data I/O, Decision making and Branching, Loop Introduction, programs with looping structure, Control Flow programs with control flow				9	
III	Array and Strings Introduction to Array, Initialization, Single dimensional array, Multidimensional array, String, Functions with string: Read, Display string and string functions, String Arrays.				9	
IV	Functions and Pointers Function Introduction, Function calling, Return type, Function types, Recursion, Types of Recursion, Introduction to Pointers, Types Pointers, Programming exercises with pointers.				9	
V	Structures and Unions Introduction to structure and simple program using structure concepts, Introduction to Union and programs with union, Storage Classes- Introduction to DMA, Introduction to Pre-processor				9	
<u>Text Book</u>						
<ol style="list-style-type: none"> 1. Introduction to Programming Languages 1st Edition by Arvind Kumar Bansal, CRC Press, Taylor and Francis group, 2014. 2. C Programming Language by Brian Kernighan and Dennis Ritchie, Prentice Hall Software, 1988. 3. Programming with C 2 nd Edition Byron Gottfried Schaum's outlines, Tata McGraw-Hill publishers, 1998. 						
<u>Reference Books</u>						
<ol style="list-style-type: none"> 1. E. Balagurusamy, 'Programming in ANSI C', 3rd edition, Tata McGraw Hill Publishers, 2004. 2. Eric C.R. Hehner, 'The Logic of Programming', Prentice hall of India, 1991. 3. C: Herbert <u>Schildt</u>, 'The Complete Reference', McGraw Hill, 4th edition, 2017 						

Andragogy

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Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Acquiring foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.	K2
C02 :	Understanding C language fundamentals	K2,K4
C03 :	Applying various types of arrays and string manipulation technique to manage and process data in programming scenarios	K3
C04 :	Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.	K4
C05 :	Develop modular programs using control structures, unions	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	3	2	2	2	3	1
C02	3	3	3	2	3	2	2	2	1
C03	3	3	2	3	2	2	3	2	3
C04	3	2	2	3	1	2	3	2	1
C05	3	2	3	2	1	2	3	3	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI113	Number of Hours/Week	4			
Semester	I	Max. Marks	100			
Course category	Applied Science	Credits	4			
Course Title	MATHEMATICS-I			L	T	P
				3	1	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To recall and remember basics of matrices, complex numbers, and differential calculus.
- To understand the concepts of basic mathematical methods for matrices, complex numbers and differential calculus.
- To apply methods to solve engineering problems.
- To analyze engineering problems and evaluate.
- To solve and evaluate the problems using matrices, complex numbers, and differential calculus.

UNIT	TOPICS	HOURS
I	Introduction to Differentiation and its applications: Fundamentals of Differentiation, Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders, Indeterminate forms and L'Hopital's rule, Maxima and Minima	10
II	Integration and its applications: Double integral, Triple integral, Change of order of integration, Change of variables, Beta and Gamma functions and their properties, Dirichlet's integral and its applications to area and volume, Liouville's extensions of Dirichlet's integral.	12
III	Sequence: Real number system, Convergence of sequence and series, Tests for convergence	8
IV	Series: Power series, Taylor's series, Series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.	8
V	Advanced Multivariable Calculus: Limit, continuity and Course Categoryial derivatives, Directional derivatives, Total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient, curl and divergence	10
VI	Advanced Matrix Theory: Introduction, types of matrices-symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, unitary matrices, Rank of a matrix - echelon form, normal form, consistency of system of linear equations (Homogeneous and Non-Homogeneous). Inverse and rank of a matrix, rank-nullity theorem	12

Text Books

- 1: Advanced Engineering Mathematics, 10th Edition, Erwin Kreyszig
- 2: Calculus and Analytical Geometry, Thomas and Finney
- 3: Veerarajan T., Engineering Mathematics-I, Tata McGraw-Hill, New Delhi, 2008.
- 4: Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books

- 1: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- 2: Principles of Mathematical Analysis, W. Rudin

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand the concepts of mean value theorems, higher order derivative, series expansion and associated problems	K2
C02 :	Acquire problem solving skills for finding area and volume using multiple integrals	K3
C03 :	Analyze sequences and series, including Fourier series	K4
C04 :	Apply the differentiation of functions of two variables for maximization and minimization	K3
C05 :	Evaluate basic matrix operations, linear systems of equations	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03
C01	2	2	1	0	0	0	1	0	0
C02	2	2	0	0	0	0	2	1	1
C03	1	2	1	0	0	0	1	2	1
C04	2	2	2	0	1	0	1	1	2
C05	3	3	1	0	0	0	2	2	0

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25AEEN911	Number of Hours/Week	3		
Semester	I	Max. Marks	100		
Course Category	Ability Enhancement Compulsory Course	Credits	3		
Course Title	EFFECTIVE COMMUNICATION	L	T	P	
		3	0	0	
COURSE OBJECTIVES:					
The main learning objective of this course is to prepare the students to:					
<ul style="list-style-type: none"> To define and explain the fundamental concepts, types, and processes of communication. To develop active listening and effective speaking skills to enhance interpersonal To improve reading comprehension skills through different techniques. To apply grammar and vocabulary rules and public communication for accurate sentence structure and effective written communication. To prepare and deliver effective presentations by planning, structuring, and overcoming stage fright. 					
UNIT	TOPICS				HOURS
I	Introduction to Communication Definition of Communication, Types of Communication: Formal, Informal, Oral, Written, Verbal, non-verbal, interpersonal, intrapersonal Process of Communication: Sender, Message, Channel, Receiver, Feedback Barriers: Intrapersonal, Interpersonal, Organizational Overcoming Barriers				8
II	Listening and Speaking: Active Listening: Types of Listening, Reasons for poor listening Traits of the good listener, Effective Speaking: Achieving Confidence, Clarity, and Fluency, Public Speaking, Drafting the Speech				5
III	Reading and Writing: Reading Comprehension: Improving Comprehension Skills, Scanning and Skimming, Predicting the Content, Understanding the Gist, PQRST Technique Grammar and Vocabulary: Sentence Structure, Preposition, Punctuation, Articles, Common errors and Correct Usage, Word formation: Affixes, Active and Passive Vocabulary				8
IV	Presentation Skills Planning: Occasion, Audience, Purpose, Thesis Statement, Material, Outlining and Structuring, Guidelines for Effective Delivery, Strategies for Reducing Stage Fright				6
V	Practice: Grammar Bites, English Fluency Drills				3
<u>Text Books</u> 1. Kumar, Sanjay and Pushp Lata. <i>Communication Skills</i> . 2 nd . ed., Oxford University Press, 2015. 2. Raman, Meenakshi and Sangeetha Sharma. <i>Technical Communication: Principles and Practice</i> , 4 th ed., Oxford University Press, 2022.					
<u>Reference Books</u> 1. Adair, John. <i>Effective Communication: The Most Important Management Skill of All</i> . Pan Books Publishers, 1997. 2. Gorrell, Robert M and Charlton Laird. <i>Modern English Handbook</i> . 6 th ed., Pentice Hall Publications, 1976. 3. Rose, William. <i>GNVQ Core Skills Communication</i> . 2 nd . ed., Pitman Publishing, 1995.					

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Identify and understand the different types and processes of communication and the barriers that may arise.	K2
C02 :	Demonstrate active listening skills and apply strategies for confident and fluent public speaking.	K3
C03 :	Analyze and enhance reading comprehension through effective reading techniques.	K4
C04 :	Utilize proper grammar, sentence structures, and vocabulary for clear and correct written communication.	K3
C05 :	Create and present structured presentations, incorporating techniques to manage stage fright and engage the audience effectively.	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	2	0	0	0	0	0	0	0	0
C02	1	0	0	0	0	0	0	0	0
C03	3	0	0	0	0	0	0	0	3
C04	3	0	0	0	0	0	0	0	2
C05	3	0	0	0	0	0	0	0	0

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI211	Number of Hours/Wk	2		
Semester	I	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	FUNDAMENTALS OF COMPUTING LAB	L	T	P	
		0	0	2	

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To have a comprehensive understanding of a foundational understanding of computer systems.
- To learn about various number systems including decimal, binary, octal, and hexadecimal
- To develop a comprehensive grasp of how computers function, the types of software used and the significance of networking in today's digital world.

LIST OF PROGRAMS

1. Basics of Microsoft Word.
2. Insert Table and Generating Chart.
3. Mail Merging.
4. Study on features of Microsoft Excel.
5. Incorporating the predefined functions in Excel.
6. Inserting table and generating chart in Excel.
7. Pivot chart, table and slicing in Excel.
8. Study on features in Microsoft PowerPoint.
9. Creating presentation incorporating the features of PowerPoint.
10. Study on HTML.
11. Basic web page design, formatting, inclusion of image and video.
12. Creation of Table.
13. Designing own web page.

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01	Understand the basic concepts of computers.	K2
C02	Analyze the basics of number systems.	K4
C03	Apply system development programs to create and manage simple software projects.	K3
C04	Analyze the performance of different memory management techniques and their impact on system efficiency.	K4
C05	Evaluate the knowledge of Internet history to understand current Internet technologies and to solve problems in communication and information access.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PS01	PSO2	PSO3
C01	3	2	0	3	0	0	2	3	1
C02	3	3	3	2	3	2	2	2	1
C03	3	3	2	3	2	2	3	2	3
C04	3	2	2	3	1	1	3	1	1
C05	3	2	2	2	1	3	2	1	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI212	Number of Hours/Wk	2		
Semester	I	Max. Marks	100		
Course category	Core Course	Credits	1		
Course Title	INTRODUCTION TO PROGRAMMING LAB	L	T	P	
		0	0	2	

COURSE OBJECTIVES:

The main aim of learning this course is to:

- To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language.
- To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language
- Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management.
- Build a foundation for advanced programming and software development. To develop skills to handle complex programming challenges such as file handling, Debugging.

LIST OF PROGRAMS

1. Write a C program to print Integer, Float, Character values
2. a) Write a c program to demonstrate use of arithmetic operators
b) Write a C program using increment and decrement operators
3. a) Write a C program using Decision making constructs (Switch case statement)
b) Program to find if a number is Negative, Positive, or zero (using if..elseif..else statement)
4. C program to perform factorial of a number
5. a) Write a C program to print a message 5 times using "while" statement
b) Illustrate the Do-while statement using C program
c) Program using for loop statement
6. a) Program to implement break statement
b) write a program to demonstrate continue statement
7. Program to insert elements into an array and display the array elements using C language
8. Program to solve multiplication of 2 matrices
9. String
 - a) Program to accept a string and display it as reverse using C language
 - b) program to concatenate 2 string using C
10. Array
 - a) Program to illustrate the concepts of arrays
 - b) Program to illustrate pointer to 2-dimensional array
11. Program to take mark details of students and display the name of the students with highest marks using Structure concept
12. Program to implement union concept

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Acquiring foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.	K2
C02 :	Understanding C language fundamentals	K2,K4
C03 :	Applying various types of arrays and string manipulation technique to manage and process data in programming scenarios	K3
C04 :	Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.	K4
C05 :	Develop modular programs using control structures, unions	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	3	2	2	2	3	1
C02	3	3	3	2	3	2	2	2	1
C03	3	3	2	3	2	2	3	2	3
C04	3	2	2	3	1	2	3	2	1
C05	3	2	3	2	1	2	3	3	1

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI121	Number of Hours/Week	3			
Semester	II	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	PYTHON PROGRAMMING			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Understand the fundamentals of the Python programming language and its historical development
- To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation.
- To demonstrate object oriented concept in python
- To familiarize with machine learning tools in python

UNIT	TOPICS	HOURS
I	Introduction to python programming Introduction to python ; setting up python programming environment; variables; strings and its operations; special characters; striping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice;	9
II	Python datatypes Tuples and its operations; relational operators; conditional statements – if, if-else, if-elif-else; multiple conditional blocks; dictionaries; key-value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting;	9
III	Loop and function While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module;	9
IV	OOPs in python Classes; <code>__init__()</code> method; instance of a class; accessing attributes; calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block;	9
V	Python machine learning tools Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python based machine learning libraries – pytorch, tensorflow; virtual environment; machine learning application using python tools;	9

Text Book

1. Matthes, Eric. *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*. 2nd ed., No Starch Press, Inc., 2019.

Reference Book

1. Sweigart, Al. *Automate the Boring Stuff with Python*. William Pollock, 2015.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Comprehend the holistic view of programming language design and behavior	K2
C02 :	Understand the programming concepts in abstract and paradigm level	K2
C03 :	Structure python programs for solving problems	K3
C04 :	Develop python programs using OOP concept	K5/K6
C05 :	Execute ML project using python tools	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PSO1	PSO2	PSO3
C01	1	3	1	2	2	1	3	2	1
C02	1	3	1	2	1	1	3	2	1
C03	2	2	2	3	2	3	3	3	2
C04	2	3	0	3	2	3	3	3	1
C05	1	3	3	3	2	3	3	2	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI122	Number of Hours/Wk	4		
Semester	II	Max. Marks	100		
Course Category	Core Course Allied	Credit	4		
Course Title	PROBABILITY ,STATISTICS AND STOCHASTIC PROCESSES	L	T	P	
		3	1	0	

COURSE OBJECTIVES

- **Understand fundamental probability concepts** and their applications in real-world scenarios.
- Analyze data using descriptive statistics **such as mean, variance, and standard deviation.**
- Apply probability distributions (**e.g., binomial, normal**) to model and solve **problems.**
- Conduct hypothesis testing and confidence intervals to **make informed statistical inferences.**
- Utilize statistical tools and software **for data analysis and decision-making invarious fields..**

UNIT	TOPIC	HOURS
I	Introduction to Probability: Introduction to set algebra-sigma algebra-Borel sigma algebra-sequence of sets and its limits-lim-sup and lim-inf of sequence of sets; Axiomatic definition of probability-probability space-properties of probability functions-conditional probability-Bayes' rule-independence of events-continuity of probability functions-Borel Cantelli lemmas.	10
II	Random variables -distribution function and its property probability mass and density functions-symmetric distribution and its properties-expectation-moments moment generating function-Markov inequality-Chebyshev's inequality.	6
III	Joint distributions -marginal and conditional distributions-moments-independence of random variables-covariance, and correlation joint moment generating functions-additive properties of random variables-functions of random variables-ordered Statistics.	8
IV	Special distributions: Discrete uniform-Bernoulli-binomial-geometric negative binomial-hypergeometric-Poisson-exponential-gamma-normal- bivariate normal distribution; Population- sample-parameters- distributions of the sample mean and the sample variance for a normal population-Chi-Square-t, F distributions-law of large numbers-central limit theorem-point estimation-method of moments-maximum likelihood estimator-unbiasedness.	8
V	Testing of hypothesis: Null and alternate hypothesis-Neyman Pearson fundamental lemma and its applications-tests for one sample and two sample problems for normal populations-tests for proportions-confidence interval estimation-confidence interval for parameters of normal population	10

Text Books:

1. First Course in Probability, Sheldon Ross, 2022.
2. An Introduction to Probability and Statistics, V.K. Rohatgi and A.K. Md. E. Saleh, 2015.

Reference Books:

1. Introduction to Probability and Statistics, S. Milton and J.C. Arnold, 2003.
2. Introduction to Mathematical Statistics, R V Hogg, A Craig and J W McKean, 2019

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Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand Basic Probability Concepts	K3
C02 :	Analyse Random Variables and Probability Distributions, Joint Distributions and Conditional Probability	K4
C03 :	Implement the Central Limit Theorem and Law of Large Numbers	K5
C04 :	Perform Hypothesis Testing and Statistical Inference, Regression and Correlation for Data Analysis	K3
C05 :	Employ Statistical Tools in Engineering Applications	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	2	2	1	0	1	0	2	1	1
C02	2	1	1	2	1	2	1	2	1
C03	2	0	2	2	2	2	2	0	2
C04	2	2	1	2	0	2	2	2	2
C05	2	2	0	2	1	2	0	0	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI123	Number of Hours/Wk	4			
Semester	II	Max. Marks	100			
Course Category	Core Course Allied	Credit	4			
Course Title	MATHEMATICS -II			L	T	P
				3	1	0

COURSE OBJECTIVES

- To develop a strong understanding of vector spaces, subspaces, basis, and dimension, as well as how linear transformations relate to matrices and their properties.
- To gain proficiency in solving systems of linear equations using techniques like Gaussian elimination, matrix operations, and determinants.
- To compute eigenvalues and eigenvectors, and apply them to diagonalize matrices, a critical tool for solving differential equations.
- To solve first-order and second-order ordinary differential equations (ODEs) with applications to physical, biological, and engineering problems.
- To understand the interplay between linear algebra and differential equations, especially in systems of linear differential equations, using matrix methods such as the Laplace transform and matrix exponentials.

UNIT	TOPIC	HOURS
I	Advanced Matrix Theory: Systems of linear equations: Elementary operations-row-reduced echelon matrices-Gauss elimination LU factorization-linear independence-rank of a matrix-solutions of linear systems-existence and uniqueness.	10
II	Vector spaces: Vector space-subspaces-spanning space-bases and dimensions. Linear transformation-matrix representations of linear transformations-range space and rank-null space and nullity-the rank and nullity theorem-invertibility.	6
III	Eigenvalues and eigenvectors: Eigen values-eigenvectors and some applications of eigenvalue problems-Hermitian, skew-Hermitian, unitary matrices and their eigenvalues-eigen bases.	8
IV	Elementary Canonical Forms: Diagonalization: Annihilating polynomial-the minimal polynomial and the characteristic polynomial-Cayley-Hamilton theorem-real quadratic form; Inner product spaces: Inner product spaces-orthonormal bases- Gram-Schmidt process.	8
V	Ordinary Differential Equations: Review of First Order ODE- Lipschitz condition-Picard's theorem; Linear differential equations: Linear dependence and Wronskian-linear ODE with constant coefficients of higher order characteristic equations- Cauchy-Euler equations-method of undetermined coefficients-method of variation of parameters- solutions methods using Laplace Transform.	10

Text Books:

1. "Linear Algebra", Hoffman Kunze, Prentice Hall. 1971
2. "Differential Equations", S. L Ross, Third Edition, 2007

Reference Books:

1. "Introduction to Linear Algebra", Gilbert Strang, Fifth edition, 2016
2. "Advanced Engineering Mathematics", Erwin Kreyszig, Wiley Publishers, Tenth Edition, 2011

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K-Level's
CO1 :	Learn different types of matrices, concept of rank, methods of matrix inversion and their applications, systems of linear equations, and manipulate vectors in various dimensions.	K3
CO2 :	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.	K4
CO3 :	Apply the concept of eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces for understanding physical and engineering problems.	K3
CO4 :	Understand the first- and second-order ordinary differential equations (ODEs), both analytically and numerically, with applications to real-world phenomena	K3
CO5 :	Develop the skills to model physical systems using differential equations and linear algebra.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's

	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03
CO1	2	1	2	2	2	1	2	1	1
CO2	2	0	1	1	0	2	1	2	1
CO3	2	2	2	2	1	1	0	2	2
CO4	2	2	2	1	2	0	2	2	2
CO5	2	1	1	0	1	0	2	2	1

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI124	Number of Hours/Wk	3			
Semester	II	Max. Marks	100			
Course Category	Core Course	Credit	3			
Course Title	OFFICE AUTOMATION TOOLS			L	T	P
				3	0	0
COURSE OBJECTIVES						
<ul style="list-style-type: none"> To gain comprehensive knowledge of various office automation tools and their applications in a professional setting. To develop proficiency in creating, formatting and managing documents using advanced features of word processing software. To acquire the ability to develop and analyze data using spreadsheet software. To manage email communications and calendar events efficiently with organizational tool in order to streamline workflow. To utilize cloud storage and collaboration tools to enhance team productivity. 						
UNIT	TOPICS				HOURS	
I	Introduction to MS Word: Overview of MS Word Interface, Creating, Saving, and Opening Documents, Basic Text Formatting (Font styles, sizes, and colors), Paragraph Formatting (Alignment, indentation, line spacing),				8	
II	Basic Document Formatting Advanced Document Formatting, Using Styles and Templates, Creating and Managing Tables, Using Headers, Footers, and Page Numbers, Creating a Table of Contents and Index. Document Review and Collaboration- Track Changes and Comments, Comparing and Merging Documents, Using and Creating Forms, Managing References and Citations, Integrating MS Word with Other MS Office Applications, Creating a Professional Report or Resume				8	
III	Data Management and Analysis with MS Excel Introduction to MS Excel: Overview of Excel Interface, Basic Operations (Entering Data, Basic Formulas), Cell Referencing and Basic Functions (SUM, AVERAGE), Data Analysis Techniques- Creating and Formatting Tables, Using Advanced Functions (VLOOKUP, INDEX-MATCH, IF Statements), Data Validation Techniques, Data Visualization- Creating and Customizing Charts, Using Conditional Formatting, Pivot Tables and Pivot Charts , Practical Applications and Project- Data Analysis Project: Import, Clean, Analyse, and Visualize Data, Automation with Macros: Recording and Running Basic Macros				8	
IV	Designing Presentations with MS PowerPoint Introduction to MS PowerPoint: Overview of PowerPoint Interface, Creating and Formatting Slides, Using Slide Layouts and Themes, Enhancing Presentations- Adding and Customizing Text, Images, and Shapes, Applying Slide Transitions and Animations, Incorporating Multimedia Elements (Audio, Video), Advanced Presentation Techniques- Designing Effective Slide Masters, Creating Interactive Elements (Hyperlinks, Action Buttons), custom Animations and Timing, Practical Applications and Project- Creating a Professional Presentation on a Given Topic, Incorporating Feedback and Revising Presentation.				10	
V	Creating and Managing Forms- Google Forms, Microsoft Forms- Designing forms and surveys- Adding different types of questions- Setting up branching logic- Collecting and analyzing responses.				10	

	Cloud storage-Collaboration tools, Desktop Publishing-Microsoft Publisher- Creating brochures, newsletters, and flyers-Using templates and design elements-Inserting and formatting text, images, and graphics- Preparing documents for printing.	
<u>Text Books:</u>		
<ol style="list-style-type: none"> 1. "Microsoft Office 2019 Step by Step", Joan Lambert and Curtis Frye, First Edition, Microsoft Press, 2018. 2. "Learning Microsoft Office", First Edition, Wiley,2019. 3. "Google Workspace User Guide", Eric Butow First Edition, , Packt Publishing, 2021. 4. "Mastering LibreOffice", Jean Hollis Weber, Friends of OpenDocument, First Edition, 2014. 5. "Microsoft Excel 2019 Bible", Michael Alexander, Richard Kusleika, and John Walkenbach, First Edition, Wiley, 2018 6. "Google Sheets: The Comprehensive Guide", Ian Lamont, First Edition, i30 Media Corporation, 2020. 7. "Microsoft PowerPoint 2019 For Dummies", Doug Lowe, First Edition, Wiley, 2018. 8. "Access 2019 Bible", Michael Alexander and Richard Kusleika, First Edition, Wiley, 2018. 		

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Create professional documents using word processing software, applying advanced features such as mail merge, styles, and templates.	K6
C02 :	Utilize complex formulas, functions, pivot tables, and data visualization tools in spreadsheet software presenting data effectively.	K3
C03 :	Design engaging presentations using presentation software, incorporating multimedia elements, custom animations, and utilizing presenter tools.	K6
C04 :	Understand fundamental database concepts to manipulate and interpret data effectively	K2
C05 :	Utilize cloud storage solutions and collaboration tools for file management, sharing, real-time collaboration, managing permissions, and ensuring data security and accessibility.	K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's

	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03
C01	2	3	2	2	1	1	2	1	2
C02	3	3	3	2	2	2	2	1	2
C03	2	2	2	2	1	2	2	1	2
C04	2	1	2	2	2	3	1	1	2
C05	3	3	2	3	2	2	2	1	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI125	Number of Hours/Wk	3		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	3		
Course Title	DISCRETE STRUCTURES FOR COMPUTER SCIENCE		L	T	P
			3	0	0
COURSE OBJECTIVES					
<ul style="list-style-type: none"> • To get familiar and understand the fundamental notions in discrete structures focusing on aspects of computer science • To describe binary relations between two sets, combine relations using set operations and composition. • To understand and demonstrate the basic concept of algorithm and its application in combinatorial mathematics. • To identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm. • To classify the basic properties of graphs and trees and model simple applications. 					
UNIT	TOPIC				HOURS
I	Set Theory and Logic Sets – Functions – Relations - Equivalence Relation – Poset - Functions Logic: Propositional logic - Truth Tables – Tautologies - Resolution Proof System - Predicate Logic				9
II	Induction and Combinatorics Peano's Axioms - Mathematical Induction - Pigeon-Hole Principle - Principle of Inclusion and Exclusion - Review of Permutations and Combinations - Distribution Problems - Derangements - Bijection Principle.				9
III	Algebraic Structures Semi-Groups – Monoids – Groups - Subgroups and Their Properties - Cyclic Groups - Cosets - Permutation Groups - Lagrange's Theorem - Cayley's Theorem - Normal Subgroups - Homomorphism of Groups - Quotient Groups -Introduction to Rings and Fields				9
IV	Linear Algebra and Recurrence Relations Linear Algebra: Vector Space – Basis, Dimension, Orthogonality - Recurrence Relations: Homogeneous and Inhomogeneous Recurrences and their Solutions - Solving Recurrences Using Generating Functions.				9
V	Graph Theory Definitions and Basic Results - Representation of a Graph by a Matrix and Adjacency List - Trees - Cycles - Properties - Paths and Connectedness - Subgraphs - Graph Isomorphism - Operations on Graphs - Vertex and Edge Cuts - Vertex and Edge Connectivity.				9
Text Books					
1. "Elements of Discrete Mathematics: A Computer Oriented Approach", C. L. Liu, D. P. Mohapatra, McGraw Hill, Third Edition, 2012. 2. "Applied Discrete Structures", Al Doerr, Ken Levasseur, LibreTexts, Third Edition, 2023					
Reference Books					
1. "Discrete Mathematical Structures with applications to Computer Science", Tremblay J.P. and Manohar R., McGraw Hill International Edition, 1987. 2. "Discrete Mathematics and Its Applications", Kenneth H. Rosen, Sixth Edition, Tata McGraw Hill, 2012.					

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K - Level's
C01 :	Understand the fundamental aspects of discrete and continuous mathematical structures.	K2
C02 :	Demonstrate the principles of mathematical induction to prove statements.	K3
C03 :	Differentiate between various algebraic structures and analyze their properties.	K4
C04 :	Apply logical reasoning and mathematical techniques to solve problems in set theory, algebra, and graph theory.	K3
C05 :	Construct new mathematical models and generate solutions to complex recurrence relations and graph problems.	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03
C01	2	0	3	3	2	2	1	1	1
C02	0	0	2	0	2	1	2	0	1
C03	1	0	2	1	2	2	2	1	0
C04	2	2	2	0	2	3	1	2	1
C05	0	0	1	2	1	2	2	1	1

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25EVST921	Number of Hours/Week	2			
Semester	II	Max. Marks	100			
Course Category	Value Added Course	Credits	2			
Course Title	ENVIRONMENTAL SCIENCE			L	T	P
				2	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- To understand the Environmental Foundations
- To differentiate between renewable and non-renewable resources and assess the impacts of land use changes, land degradation, and water resource exploitation.
- To study the causes and effects of pollution and its impacts on earth
- To analyse the population causes, its effects and control measures.

UNIT	TOPICS	HOURS
I	Introduction to Environmental studies Definition and Scope of Environmental Studies - Interdisciplinary Nature of Environmental Science-Historical Perspectives on Environmental Issues-Principles of Sustainability and Sustainable Development, Ecosystem- Structure and functions of ecosystem--Aquatic ecosystems	6
II	Natural Resources- Renewable and Non-renewable Resources Land resources and land use change, Land degradation, soil erosion, Desertification- Deforestation- exploitation of surface and ground water, floods, droughts, conflicts over water Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	6
III	Biodiversity and Conservation Levels of biological diversity- genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots.	6
IV	Environmental Pollution Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution - Nuclear hazards and human health risks-Solid waste management: Control measures of urban and industrial waste. Pollution case studies, Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment Laws: Environment Protection Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.	12
V	Human Communities and the Environment Human population growth: Impacts on environment, human health and welfare-Resettlement and rehabilitation of project affected persons, Disaster management: floods, earthquake, cyclones and landslides, Environmental movements- Chipko, Silent valley, Bishnoi's of Rajasthan	10

Textbooks

1. Environmental and Sustainable Development, Keiji Ujikawa, Mikio Ishiwatari, Eric van Hullebusch, 1st Edition springer publishers Singapore.
2. Environmental Science: Toward A Sustainable Future, Dorothy F. Bourse and Richard T. Wright, 13th edition, Pearson publishers.
3. Social Learning in Environmental Management: Towards a Sustainable Future, Meg Keen, Valerie A. Brown, Rob Dyball.

4. Principles of Environmental Science, William P. Cunningham and Mary Ann Cunningham, 10th edition, Mc graw hill publishers.
5. Visualizing Environmental Science, Linda R. Berg, Mary Catherine Hager and David M. Hassenzahl.

Reference Books:

1. Waste Water Treatment, Rao, M.N., Datta, A.K., Oxford and IBH Publishing Co. Pvt. Ltd, 1987.
2. Fundamentals of Ecology, Odum, E.P., Odum, H.T., and Andrews, J., , Saunders, Philadelphia, 1971, USA.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar,

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Define environmental studies and its interdisciplinary nature	K1
CO2 :	Analyze the structure and functions of various ecosystems, including aquatic ecosystems.	K2,K4
CO3 :	Evaluate the growing energy needs and the role of alternative energy sources	K5
CO4 :	Understand levels of biodiversity (genetic, species, and ecosystem) and identify biodiversity hotspots, with a focus on conservation strategies.	K2,K3
CO5 :	Evaluate the effects of human population growth on the environment and the importance of disaster management, resettlement, and environmental movements	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	0	1	0	0	0	1	0	0	0
CO2	0	0	0	0	0	1	0	0	0
CO3	0	0	0	0	0	1	0	0	0
CO4	0	0	0	0	0	1	0	0	0
CO5	0	0	0	0	0	1	0	0	0

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI221	Number of Hours/Wk	2		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	1		
Course Title	PYTHON PROGRAMMING LABORATORY		L	T	P
			0	0	2
COURSE OBJECTIVE:					
The main learning objective of this course is to prepare the students for:					
<ul style="list-style-type: none"> To learn fundamentals in python programming language To introduce python modules for application To familiarize python framework for machine learning applications To develop machine learning application using python To implement research topic as Course Category of python project 					
LIST OF EXPERIMENTS					
<ol style="list-style-type: none"> Implement basic algebraic problems to get into python programming Implement string manipulations problems using python Implement problems using python datatypes such as tuple, list, dictionary etc. Implement problems for python loops, conditional statements and functions Implement object oriented programming concepts in python to solve different problems Implement problems for python file manipulations Implement standard machine learning algorithms using python frameworks such as TensorFlow, PyTorch etc. Implement advanced problems using python tools in a virtual environment as Course Category of python project 					

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K-Level's
C01 :	Comprehend the holistic view of programming language design and behavior	K2
C02 :	Understand the programming concepts in abstract and paradigm level	K2
C03 :	Structure python programs for solving problems	K3
C04 :	Develop python programs using OOP concept	K5/K6
C05 :	Execute ML project using python tools	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PSO1	PSO2	PSO3
C01	1	3	1	2	2	1	3	2	1
C02	1	3	1	2	1	1	3	2	1
C03	2	2	2	3	2	3	3	3	2
C04	2	3	0	3	2	3	3	3	1
C05	1	3	3	3	2	3	3	2	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI222	Number of Hours/Wk	2		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	1		
Course Title	OFFICE AUTOMATION TOOLS LAB		L	T	P
			0	0	2

COURSE OBJECTIVES

- To gain comprehensive knowledge of various office automation tools and their applications in a professional setting.
- To develop proficiency in creating, formatting and managing documents using advanced features of word processing software.
- To acquire the ability to develop and analyze data using spreadsheet software.
- To manage email communications and calendar events efficiently with organizational tool in order to streamline workflow

List of Experiment

- 1. Introduction to Office Automation Tools**
 - Overview of different office automation tools.
 - Understanding the interface and basic functionalities of popular office suites (Microsoft Office, Google Workspace).
- 2. Word Processing (e.g., Microsoft Word, Google Docs)**
 - Creating and formatting documents.
 - Using templates and styles.
 - Inserting and formatting tables, images, and charts.
 - Utilizing headers, footers, and page numbers.
 - Implementing document review features: track changes, comments, and comparing documents.
 - Mail merge for letters and labels.
- 3. Spreadsheet Management (e.g., Microsoft Excel, Google Sheets)**
 - Creating and formatting spreadsheets.
 - Basic and advanced formulas and functions.
 - Data validation and conditional formatting.
 - Chart creation and customization.
 - Using pivot tables and pivot charts for data analysis.
 - Implementing macros to automate repetitive tasks.
- 4. Presentation Software (e.g., Microsoft PowerPoint, Google Slides)**
 - Creating and designing presentations.
 - Using themes and templates.
 - Adding and formatting text, images, audio, and video.
 - Applying animations and slide transitions.
 - Presenter view and slide show settings.
 - Collaborating on presentations in real-time.
- 5. Database Management (e.g., Microsoft Access, LibreOffice Base)**
 - Introduction to database concepts.
 - Creating and managing tables.
 - Designing and running queries.
 - Creating forms for data entry.
 - Generating reports.
- 6. Email and Calendar Management (e.g., Microsoft Outlook, Google Calendar)**
 - Composing, sending, and organizing emails.
 - Using folders, labels, and rules to manage emails.
 - Scheduling, managing calendar events, setting up reminders and notifications.
 - Sharing calendars and scheduling meetings.

<p>7. Collaboration and Cloud Storage (e.g., Microsoft OneDrive, Google Drive)</p> <ul style="list-style-type: none"> ○ Uploading and managing files in cloud storage, sharing files and setting permissions. ○ Real-time collaboration on documents. ○ Version control and file recovery. <p>8. Creating and Managing Forms (e.g., Google Forms, Microsoft Forms)</p> <ul style="list-style-type: none"> ○ Designing forms and surveys. ○ Adding different types of questions. ○ Setting up branching logic- Collecting and analyzing responses. <p>9. Desktop Publishing (e.g., Microsoft Publisher)</p> <ul style="list-style-type: none"> ○ Creating brochures, newsletters, and flyers, using templates and design elements. ○ Inserting and formatting text, images, and graphics, preparing documents for printing
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Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Create professional documents using word processing software, applying advanced features such as mail merge, styles, and templates.	K6
C02 :	Utilize complex formulas, functions, pivot tables, and data visualization tools in spreadsheet software presenting data effectively.	K3
C03 :	Design engaging presentations using presentation software, incorporating multimedia elements, custom animations, and utilizing presenter tools.	K6
C04 :	Understand fundamental database concepts to manipulate and interpret data effectively	K2
C05 :	Utilize cloud storage solutions and collaboration tools for file management, sharing, real-time collaboration, managing permissions, and ensuring data security and accessibility.	K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PSO1	PSO2	PSO3
C01	2	3	2	2	1	1	2	1	2
C02	3	3	3	2	2	2	2	1	2
C03	2	2	2	2	1	2	2	1	2
C04	2	1	2	2	2	3	1	1	2
C05	3	3	2	3	2	2	2	1	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

SEMESTER III

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI131	Number of Hours/Wk	3			
Semester	III	Max. Marks	100			
Course Category	CORE	Credits	3			
Course Title	ARTIFICIAL INTELLIGENCE			L	T	P
			3	0	0	
<u>COURSE OBJECTIVES</u>						
<p>The main aim of learning this course is to:</p> <ul style="list-style-type: none"> • To explore history and revolution of artificial intelligence • To formulate artificial intelligence problem by defining intelligent agent and its environment • To learn problem solving approaches through state space search and its different algorithms. • To develop an AI model with the help of concepts such as state space search, adversarial search, knowledge representation, inference etc. 						
UNIT	TOPICS				HOURS	
I	Introduction to AI Introducing the structure and scope of the course; Introduction and History of AI; Turing Test; Chinese Room Argument; Milestones in AI; AI Project Discussion – Problem finding, Project resources, Report writing; Intelligent agent – Sensors and Actuators; Examples of Agents; Rationality – perfect and bounded rationality;				9	
II	Intelligent agent and state space search Intelligent agent and its environment; Types of environments; Multi- agent environment; Structure of the agent – table based agent, percept based agent, state based agent, goal based agent, utility based agent; Subsumption architecture; Learning agent; State and State space definition; State space search; Problem formulation; 8 Queens problem; 8 Puzzle problem; Problem formulation examples;				9	
III	Uninformed and Informed Searches Uninformed search – Breadth first search, Depth first search, Depth limited search, Iterative deepening search, Bidirectional search, Uniform cost search; Informed Search – Greedy best first search, A* search, Memory-bounded search; Heuristic function;				9	
IV	Local search and adversarial search Search in complex environment; Local search and optimization problems; Hill-climbing search; Simulated annealing; Local beam search; Adversarial search; Game theory – Two-player zero-sum games – max and min, utility function, state space graph, game tree, tic-tac-toe example; Minimax search; Alpha-Beta pruning;				9	
V	Constraint satisfaction and Knowledge representation Constraint satisfaction problem; satisfiability; propagating constraints; forward checking; backward checking; Knowledge representation – Logic, Propositional logic, Reasoning, Modus Ponens; First order logic; quantifiers; Mathematics behind machine learning – Linear algebra basics				9	

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
2. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Describe the history behind artificial intelligence	K6
C02 :	Illustrate fundamental AI concepts	K3
C03 :	Demonstrate problem formulation in state space search	K6
C04 :	Infers adversarial search with alpha-beta pruning	K6
C05 :	Develop an AI model for existing problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	1	2	1	0	0	1	2	0	0
C02	3	2	3	3	0	2	0	3	3
C03	3	1	2	2	0	2	1	1	3
C04	3	1	2	2	0	2	0	1	2
C05	2	2	3	3	3	1	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI132	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Course Category	CORE COURSE	Credits	3			
Course Title	COMPUTER NETWORK			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To understand the concept of Computer network • To Category knowledge about networking and inter networking devices 						
UNIT	TOPICS				HOURS	
I	Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.				8	
II	Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues - Error Detection and Correction.				7	
III	Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer - Channel Allocation Problem - Multiple Access Protocols - Bluetooth.				12	
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols.				10	
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography.				8	
<p><u>Text Book :</u> 1. A. S. Tanenbaum, Computer Networks, Prentice-Hall of India 2008, 4th Edition.</p> <p><u>Reference Books:</u> 1. Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition. 2. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.</p>						

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	To Learn various principles & concepts of Computer networks.	K1
C02 :	To Analyze different network models.	K4
C03 :	To Evaluate the data flow through TCP/IP & ISO Layers.	K5
C04 :	To Assess key networking protocols and their hierarchical relationship In the conceptual model like TCP/IP and OSI	K5,K6
C05 :	To Identify networking and inter-networking devices	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	0	0	0	3	0	0
C02	3	3	2	0	1	0	2	2	0
C03	3	3	3	2	0	0	3	3	3
C04	3	2	2	0	2	0	2	2	2
C05	3	3	3	1	1	1	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI133	Number of Hours/Week	3			
Semester	III	Max. Marks	100			
Course Category	CORE COURSE	Credits	3			
Course Title	DIGITAL DESIGN			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> To teach various number systems, binary codes and their applications To familiarize the students, the importance of error detection and error correction codes. To inculcate concepts of K-MAP to simplify a Boolean expression To facilitate students in designing a logic circuit 						
UNIT	TOPICS				HOURS	
I	Number Representations: Binary numbers: binary, octal, and hexadecimal number systems; conversion between different number systems; signed and unsigned numbers; representation of negative numbers using 1's complement and 2's complement. Integer representation: fixed-point number representation; range and precision of fixed-point numbers; overflow and underflow conditions. Floating-point representation, Arithmetic operations in binary: binary addition, subtraction, multiplication, and division; overflow detection and handling.				7	
II	Combinatorial Circuits: Boolean Algebra: fundamental theorems and postulates; simplification of Boolean expressions using algebraic techniques. Logic Gates: basic gates (AND, OR, NOT), universal gates (NAND, NOR), XOR and XNOR gates. Minimization of Boolean functions: simplification using Boolean identities; Karnaugh map (K-map) technique for 2, 3, 4, and 5 variables; don't care conditions in K-maps. Combinational Circuits: design and analysis of arithmetic circuits (adders, subtractors); code converters (Binary to Gray, Gray to Binary, BCD to Binary, etc.); multiplexers, demultiplexers, encoders, decoders.				12	
III	Sequential Circuits: Introduction to sequential circuits: difference between combinational and sequential circuits; clock signals and timing diagrams. Latches and Flip-Flops: SR Latch, D Latch, JK Flip-Flop, D Flip-Flop, T Flip-Flop; timing constraints: setup time, hold time, propagation delay. Counters: asynchronous (ripple) counters and synchronous counters; modulus of counters; design of up-down counters, ring counters, Johnson counters. Shift Registers: serial-in serial-out (SISO) registers, serial-in parallel-out (SIPO) registers, parallel-in serial-out (PISO) registers; applications of shift registers.				12	
IV	Data Converters: purpose of sample and hold circuits in digital signal processing; working principle and block diagram. Analog to Digital Converters (ADCs): working principle of ADCs and Digital to Analog Converters (DACs): working principle of DACs				7	
V	Memory and Programmable Logic: Introduction to memory: classification of memory: volatile vs non-volatile, primary vs secondary; characteristics of memory: access time, memory cycle time, and bandwidth. Random Access Memory (RAM): types of RAM: memory cell architecture and organization. Memory decoding: address decoding techniques for RAM; row and column address selection. Read Only Memory (ROM): types of ROM, Programmable Logic Array (PLA) architecture; Programmable Array Logic (PAL) structure				7	

Text Book

1. "Digital Design" by M. Morris Mano, Michael D. Ciletti
2. Digital Systems: Principles and Applications" by Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss
3. "Microelectronics: Digital and Analog Circuits and Systems" by Jacob Millman and Arvin Grabel

Reference Books

1. Roth (2004), Fundamentals of Logic Design, 5th Edition, Thomson, India.
2. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson, 2nd Ed.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand various number systems and their arithmetic operations.	K1
CO2 :	Design and analyze combinatorial circuits using Boolean algebra, K-maps, and logic gates.	K4
CO3 :	Work with sequential circuits like latches, flip-flops, counters, and shift registers.	K5
CO4 :	Interface and design systems using data converters like ADCs and DACs.	K5,K6
CO5 :	Explore different types of memory and programmable logic devices and apply them in digital systems.	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	2	1	1
CO2	3	3	3	3	3	2	3	2	1
CO3	3	2	3	3	3	3	3	3	2
CO4	3	2	3	3	3	3	2	3	2
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI134	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	DATA STRUCTURE AND ALGORITHMS		L	T	P
			3	0	0
COURSE OBJECTIVES:					
The main learning objective of this course is to prepare the students for:					
<ul style="list-style-type: none"> To Comprehensive understanding of fundamental data structures and algorithms. To equip algorithms with the skills to analyze and implement various computational techniques. Learn to select appropriate data structures for solving complex problems, optimize algorithm performance, and gain insight into advanced topics such as dynamic programming and NP-completeness. 					
UNIT	TOPICS				HOURS
I	Introduction to Data Structures Algorithms- asymptotic notations and analysis- Analysing Algorithms - Insertion sort, Divide and Conquer approach, Sorting, Building Heaps, Heap sort, Quick sort, Analysis of sorting algorithms,				12
II	Elementary data structures Stacks and Queues, linked lists and its operations, Hash Tables - Direct and Open addressing- Tree data structure Tree- Tree Traversals-Binary Search Trees-Red Black Trees - Red-black trees and its operations. B-Tree-Insertion-Deletion.				10
III	Dynamic programming Memoization, Tabulation, Rod Cutting, Matrix Chain Multiplication, Longest common subsequence, Greedy Algorithms- Introducing greedy approach, activity selection problem, Huffman codes, Graphs, Trees and Algorithms				8
IV	Introducing spanning trees, Minimum spanning tree, algorithms, Kruskal, Prims, Bellman-Ford algorithm, Single source shortest path in directed acyclic graphs, Dijkstra's algorithms, Floyd-Warshall algorithm				8
V	NP-Completeness Polynomial time, Verification algorithms, NP-Complete, NP-Hard				7
<u>Text Book</u>					
<ol style="list-style-type: none"> Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022. Data Structures and Algorithms In C++, 2nd Edition by Michael T. Goodrich Data Structures and Algorithms Made Easy by Narasimha Karumanchi. Fundamentals of Data Structures by Ellis Horowitz and Sartaj Sahni 					
<u>Reference Books</u>					
<ol style="list-style-type: none"> Chitra.A, Rajan.P.T , (2016), <i>Data Structures</i>, Vijay Nicol Imprints Pvt Ltd, McGraw-Hill Education of India Pvt Ltd, India, Second Edition. 					

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand the Fundamental Data Structures.	K2
CO2 :	Applying the concept of stack, queue, list, binary search tree and Red black tree.	K3
CO3 :	Analyzing the dynamic programming , greedy algorithms and binary search trees, including performing tree traversals, insertions, and deletions..	K4
CO4 :	Utilize graph representations and perform operations.	K3
CO5 :	Evaluating the implications of computational complexity for algorithm design and problem-solving strategies, including approaches for handling NP-Complete and NP-Hard problems.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	0	3	2	1
CO2	3	3	3	2	2	0	3	2	2
CO3	3	3	3	3	2	1	3	3	3
CO4	3	2	2	3	2	1	3	3	3
CO5	3	2	3	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI135	Number of Hours/Wk	3			
Semester	III	Max. Marks	100			
Course Category	CORE COURSE	Credit	3			
Course Title	OBJECT ORIENTED PROGRAMMING			L	T	P
				3	0	0
COURSE OBJECTIVES						
<ul style="list-style-type: none"> • To demonstrate a clear understanding of the necessity and principles of Object-oriented programming. • To create applications focusing on Object oriented programming concepts. • To manage memory using pointers leveraging C++ streams and STL container. • To develop reusable and modular code using the concepts learned. • To write diversified solutions using C++ language. 						
UNIT	TOPIC				HOURS	
I	Introduction Object Oriented Programming Necessity – Differences between procedural and Object-oriented programming- characteristics of object-oriented languages - C and C++, Functions Need of functions, Returning values from functions, Member functions -Types, Object oriented concepts- Introduction – Class, Objects, data abstraction, encapsulation, inheritance, polymorphism, Class and object creation, Simple class and object				9	
II	Operations with objects Initialization of class objects- Constructor and Destructor- constructor- Default- parameterized -Copy, Objects as function arguments-Returning objects from functions-Memory allocation for objects, Member function definition- Member functions defined- Inside and outside the class				9	
III	Overloading and Functions Operator overloading- Fundamentals of operator overloading- restriction- operator functions as class members-overloading unary and binary operators- Function Overloading- Friend and Virtual Functions- Data Abstraction, Encapsulation -its application				9	
IV	Inheritance and Polymorphism Base Class-Derived Class- Base-Class Access Control- protected base class- inheritance-Inheriting Multiple Base Classes-Virtual Base Classes- Types of Inheritance- Public and Private inheritance, aggregation: Classes within classes, inheritance and program development, Virtual Functions and polymorphism, Calling Virtual Function through Base Class Reference-Hierarchical- Pure virtual functions				9	
V	Pointers and files Early binding and Late binding, Pointers- Addresses and pointers- the address of operator and pointer and arrays- Memory management: New and Delete, pointers to objects, debugging pointers, References and Dynamic Allocation Operators, Exception Handling-Try-catch class types - C++ Streams Stream classes-formatted I/O, File I/O, The Standard Template Library Overview of STL- Containers- associated programs.				9	
Text Books						
1. "C++ The Complete Reference" Herbert Schildt, Fourth Edition, Tata McGraw Hill Publication, 2017						

2. "Object Oriented Programming in C++", Robert Lafore, Fourth Edition, SAMS publications, 2002

Reference Books

1. "C++ How to Program", Deitel and Deitel, Third Edition, Pearson Publication, 2000
2. "Object-oriented programming using C++", Joyce Farrell, Fourth Edition, Cengage Learning, 2009

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Recall the concepts of structured programming.	K2
C02 :	Understand the differences between structure programming and object-oriented programming	K3
C03 :	Able to execute C++ programs utilizing member functions	K4
C04 :	Implement operator and function overloading to extend the capabilities of the programs	K3
C05 :	Create classes and objects employing data abstraction, encapsulation, inheritance and polymorphism in real-world scenarios	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	1	1	2	2	1	1	2	1	1
C02	1	1	2	1	2	2	1	1	2
C03	2	2	2	3	3	3	1	1	2
C04	2	2	2	3	3	3	1	1	1
C05	2	2	2	2	2	2	1	2	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI231	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Course Category	CORE COURSE	Credits	1			
Course Title	DIGITAL DESIGN LAB			L	T	P
				0	0	2
COURSE OBJECTIVES:						
The main aim of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To teach various number systems, binary codes and their applications • To familiarize the students, the importance of error detection and error correction codes. • To inculcate concepts of K-MAP to simplify a Boolean expression • To facilitate students in designing a logic circuit 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex NOR gates. 2. Construction of half and full adder using XOR and NAND gates and verification of its operation. 3. To Study and Verify Half and Full Subtractor 4. Realization of logic functions with the help of Universal Gates (NAND, NOR) 5. Construction of a NOR gate latch and verification of its operation 6. Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates 7. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers 8. Implementation and verification of decoder or de-multiplexer and encoder using logic gates 9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates 10. Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK Flip Flop 11. Verify Binary to Gray and Gray to Binary conversion using NAND gates only 12. Verify the truth table of one bit and two bit comparator using logic gates 						

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand various number systems and their arithmetic operations.	K1
C02 :	Design and analyze combinatorial circuits using Boolean algebra, K-maps, and logic gates.	K4
C03 :	Work with sequential circuits like latches, flip-flops, counters, and shift registers.	K5
C04 :	Interface and design systems using data converters like ADCs and DACs.	K5,K6
C05 :	Explore different types of memory and programmable logic devices and apply them in digital systems.	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03
C01	3	1	2	2	2	1	2	1	1
C02	3	3	3	3	3	2	3	2	1
C03	3	2	3	3	3	3	3	3	2
C04	3	2	3	3	3	3	2	3	2
C05	3	3	3	3	3	3	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI232	Number of Hours/Wk	2		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	DATA STRUCTURE AND ALGORITHMS LAB	L	T	P	
		0	0	2	

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Comprehensive understanding of fundamental data structures and algorithms.
- To equip algorithms with the skills to analyze and implement various computational techniques.
- To select appropriate data structures for solving complex problems and optimize algorithm performance.
- To gain insight into advanced topics such as dynamic programming and NP-completeness.

List of Experiments

1. Insertion sort
2. Divide and conquer approach
3. Quick sort, Merge sort, Heap sort
4. Find mean , median , mode
5. Implement a stack using an array with push and pop operations. Find the top element of the stack and check if the stack is empty or not.
6. Implementation of swap() function using stack
7. Implement two stacks in an array by dividing the space into two halves
8. Sort a stack using a temporary stack
9. Implement a queue with push and pop operation.
10. Enqueue the elements in the queue using emplace() function.
11. Implementation of swap() function using queue.
12. Implement a singly linked list, double linked list with basic operations.
13. Implement a hash table using direct addressing and indirect addressing
14. Implement a binary search tree with insertion and traversal
15. Implement a red-black tree including:
 - a. Basic Red-Black Tree Properties
 - b. Rotations (Left and Right)
 - c. Insertion with Balancing
 - d. Deletion with Balancing
16. Memoization
 - a. Rod Cutting
 - b. Matrix Chain Multiplication
 - c. Longest Common Subsequence
17. Tabulation
 - a. Rod Cutting (Tabulation)
 - b. Matrix Chain Multiplication(Tabulation)
18. Greedy Algorithms
 - a. Activity Selection Problem
 - b. Huffman Codes
19. Graphs
 - a. Depth First Search (DFS)
 - b. Breadth First Search (BFS)

<ul style="list-style-type: none"> c. Dijkstra's Algorithm (Shortest Path in Weighted Graph) d. Kruskal's Algorithm (Minimum Spanning Tree)
20. Tree Algorithms <ul style="list-style-type: none"> a. Binary Search Tree (BST) Operations b. AVL Tree (Balanced BST) Insertions
21. B-Tree and Its Operations
22. Prim's Algorithm
23. Shortest Path Algorithms <ul style="list-style-type: none"> a. Bellman-Ford Algorithm b. Floyd-Warshall Algorithm c. Single Source Shortest Path in Directed Acyclic Graphs (DAGs)
24. Polynomial Time Algorithm for Sorting
25. Verifying a Solution for the Knapsack Problem
26. NP-Complete Problem Example: 3-SAT Problem
27. NP-Hard Problem Example: Traveling Salesman Problem (TSP)

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand the Fundamental Data Structures.	K2
C02 :	Applying the concept of stack, queue, list, binary search tree and Red black tree.	K3
C03 :	Analyzing the dynamic programming , greedy algorithms and binary search trees, including performing tree traversals, insertions, and deletions..	K4
C04 :	Utilize graph representations and perform operations.	K3
C05 :	Evaluating the implications of computational complexity for algorithm design and problem-solving strategies, including approaches for handling NP-Complete and NP-Hard problems.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	1	1	0	3	2	1
C02	3	3	3	2	2	0	3	2	2
C03	3	3	3	3	2	1	3	3	3
C04	3	2	2	3	2	1	3	3	3
C05	3	2	3	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI233	Number of Hrs/Week	2		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	OBJECT ORIENTED PROGRAMMING LAB		L	T	P
			0	0	2
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To demonstrate a clear understanding of the necessity and principles of Object-oriented programming. To create applications focusing on Object oriented programming concepts. To manage memory using pointers leveraging C++ streams and STL container. To develop reusable and modular code using the concepts learned. To write diversified solutions using C++ language. 					
<u>LIST OF EXPERIMENTS</u>					
<ol style="list-style-type: none"> Structure of a basic C++ object-oriented program and the difference between a structured program Classes and Objects Access specifiers Member functions and types Constructors and Destructors Pointers (Referencing and Dereferencing) Dynamic memory allocation Data Abstraction along with encapsulation Inheritance and its types Polymorphism Function overloading and operator overloading Exception handling Template class Abstract Base Class with Concrete Methods Virtual Functions 					

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Recall the concepts of structured programming.	K2
CO2 :	Understand the differences between structure programming and object-oriented programming	K3
CO3 :	Able to execute C++ programs utilizing member functions	K4
CO4 :	Implement operator and function overloading to extend the capabilities of the programs	K3
CO5 :	Create classes and objects employing data abstraction, encapsulation, inheritance and polymorphism in real-world scenarios	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03
C01	1	1	2	2	1	1	2	1	1
C02	1	1	2	1	2	2	1	1	2
C03	2	2	2	3	3	3	1	1	2
C04	2	2	2	3	3	3	1	1	1
C05	2	2	2	2	2	2	1	2	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI234	Number of Hours/Week	2			
Semester	III	Max. Marks	100			
Course Category	CORE COURSE	Credits	1			
Course Title	COMPUTER NETWORK LAB			L	T	P
				0	0	2
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> • To understand the concept of Computer network • To import Category knowledge about networking and inter networking devices 						
<u>List of Experiment</u>						
<ol style="list-style-type: none"> 1. Implement the data link layer framing methods such as character, character stuffing and bit stuffing. 2. Implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP. 3. Implement Dijkstra’s algorithm to compute the Shortest path thru a graph. 4. Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing 5. table art each node using distance vector routing algorithm 6. Take an example subnet of hosts. Obtain broadcast tree for it. 7. Take a 64 bit playing text and encrypt the same using DES algorithm. 8. Write a program to break the above DES coding 9. Using RSA algorithm encrypt a text data and Decrypt the same. 						

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	To Learn various principles & concepts of Computer networks.	K1
CO2 :	To Analyze different network models.	K4
CO3 :	To Evaluate the data flow through TCP/IP & ISO Layers.	K5
CO4 :	To Assess key networking protocols and their hierarchical relationship In the conceptual model like TCP/IP and OSI	K5,K6
CO5 :	To Identify networking and inter-networking devices	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	0	0	0	3	0	0
C02	3	3	2	0	1	0	2	2	0
C03	3	3	3	2	0	0	3	3	3
C04	3	2	2	0	2	0	2	2	2
C05	3	3	3	1	1	1	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

SEMESTER IV

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI141	Number of Hrs/Wk	3			
Semester	IV	Max. Marks	100			
Course Category	CORE COURSE	Credit	3			
Course Title	MACHINE LEARNING			L	T	P
			3	0	0	
COURSE OBJECTIVE						
<ul style="list-style-type: none"> • To explore fundamental concepts in machine learning • To equip different concepts in machine learning with mathematical intuition • To construct an existing problem into standard machine learning paradigm • To develop an innovative ML model for research problems using different ML tools and standard datasets. 						
UNIT	TOPIC				HOURS	
I	Introduction to machine learning Introduction to machine learning; Mathematics behind machine learning; Linear algebra - Vector space, system of linear equations, projection, Solving $Ax=b$, projection, least square problem, eigen values and vectors, eigen decomposition, singular value decomposition; Probability – expectation, variance, covariance; Multivariable calculus basics;				10	
II	Linear and Logistic Regression Linear Regression – cost function, optimization function; gradient descent – batch, mini-batch, stochastic; normal equation; regularization -ridge regression; feature scaling; logistic regression – sigmoid function, solving cost function; maximum likelihood estimation; gaussian discriminant analysis; naïve bayes;				10	
III	SVM and Bayesian learning Support vector machine – linear discriminant analysis, KKT theorem, primal-dual problem; Kernels – polynomial, gaussian; decision trees – information gain, gini index; Bayesian learning – bayes minimum risk classifier; multivariate normal distribution; softmax classifier; Non- linear functions – threshold, sigmoid, ReLU, tanh;				8	
IV	Neural Networks and CNN Neural networks; perceptron; multilayer perceptron; backpropagation algorithm; autoencoder – deep autoencoder, sparse auto encoder, denoising autoencoder; convolution; convolutional neural network – pooling, padding, strided convolution; CNN example – LeNet, AlexNet, VGGNet, ResNet, GoogleNet;				8	
V	Clustering and Dictionary learning Clustering – K-means, K-medoids; issues in deep learning – vanishing/exploding gradient problem, overfitting, covariate shift; momentum optimizer; Nesterov accelerated gradient; adagrad; RMS prob; ada delta; underdetermined system of linear equations; pursuit algorithms; sparse coding; dictionary learning;				8	

Text Books:

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.

Reference Books:

1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	K2
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	K3
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	K4
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	K3
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	3	2	3	3	3	3	1
CO2	3	2	2	3	3	2	3	3	2
CO3	3	2	2	3	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI142	Number of Hrs/Week	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	DATABASE MANAGEMENT SYSTEMS		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

UNIT	TOPICS	HOURS
I	Data base System Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models , the ER Model , Relational Model , Other Models , Database Languages , DDL , DML , database Access for applications Programs, data base Users and Administrator , Transaction Management , data base Architecture, Storage Manager , the Query Processor Data base design and ER diagrams , ER Model, Entities, Attributes and Entity sets , Relationships and Relationship sets , ER Design Issues, Concept Design , Conceptual Design for University Enterprise. Introduction to the Relational Model, Structure, Database Schema, Keys, Schema Diagrams.	8
II	Relational Query Languages, Relational Operations. Relational Algebra, Selection and projection set operations, renaming , Joins , Division , Examples of Algebra overviews , Relational calculus , Tuple relational Calculus , Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions , GROUPBY , HAVING, Nested Sub queries, Views, Triggers.	8
III	Normalization, Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms , dependency preservation, Boyee/Codd normal form. Higher Normal Forms ,Introduction, Multi, valued dependencies and Fourth normal form, Join dependencies and Fifth normal form	8
IV	Transaction State, Implementation of Atomicity and Durability, Concurrent, Executions, Serializability, Recoverability , Implementation of Isolation , Testing for serializability, Lock ,Based Protocols , Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log Based Recovery , Recovery with Concurrent Transactions , Buffer Management , Failure with loss of nonvolatile storage,Advance Recovery systems, Remote Backup systems.	8
V	File organization, various kinds of indexes. Query Processing, Measures of query cost , Selection operation , Projection operation , Join operation , set operation and aggregate operation , Relational Query Optimization , Transacting SQL queries , Estimating the cost , Equivalence Rules.	8

Text Books:

1. Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.

Reference Books:

1. Fundamentals of Database Systems, Elmasri Navathe Pearson Education.
2. An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition for UNIT III.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	K2
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	K3
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	K4
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	K3
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	3	2	3	3	3	3	1
CO2	3	2	2	3	3	2	3	3	2
CO3	3	2	2	3	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI143	Number of Hours/Week	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	
		3	0	0	
COURSE OBJECTIVES:					
The main learning objective of this course is to prepare the students for:					
<ul style="list-style-type: none"> ● To understand the basic hardware and software issues of computer organization ● To understand the representation of data at machine level ● To understand how computations are performed at machine level ● To understand the memory hierarchies, cache memories and virtual memories ● To learn the different ways of communication with I/O devices 					
UNIT	TOPICS				HOURS
I	Fundamentals of Computer Architecture and Organization Overview of Organization vs. Architecture - Functional components: Registers, Register files, Interconnection of components - IAS computer function, von Neumann & Harvard architectures - CISC vs. RISC architectures - Introduction to Instruction Sets - Instruction Set Architecture (ISA), instruction formats, instruction set categories - Addressing modes - Phases of instruction cycle				10
II	Data Representation and Arithmetic Operations Representation of data: Binary, Hex, Character codes - Fixed-point arithmetic: Booth's Algorithm, Modified Booth's; Restoring and Non-restoring Division - Floating-point arithmetic: Addition, Subtraction, Multiplication, Division - ALU concepts - Performance Metrics: Execution time, MIPS, MFLOPS				8
III	Control Unit and High Performance Processors Datapath and Control Unit: Hardwired Control; Microprogrammed Control - Pipelining: Two-stage, Multi-stage - Hazards: Structural, Data, Control - Hazard resolution techniques and limitations - Branch handling techniques - Flynn's taxonomy (SISD, SIMD, MISD, MIMD) - Superscalar and Super pipeline architectures - Amdahl's Law, Speed-up and Efficiency				10
IV	Memory System Organization and Storage Subsystems Memory hierarchy & types - Byte storage methods, conceptual view of memory cells - RAM and ROM, scalable memory design - Cache memory: Mapping techniques, Replacement policies, Management techniques, Mean access time evaluation - Memory Interleaving and Address mapping - External Storage: SSDs, Disk structure - RAID levels, ECC (Error detection & correction) - Reliability of memory systems				10
V	Interfacing, Communication and I/O Systems I/O Fundamentals: Handshaking, Buffering, I/O Modules - I/O Techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access (DMA), Direct Cache Access - Interrupt structures: Vectored, Prioritized - Bus systems: Synchronous & Asynchronous - Bus Arbitration Techniques - I/O Performance considerations				8

Text Books:

1. David A. Patterson, John L. Hennessey, "Computer Organization and Design, The Hardware/Software Interface", Fifth Edition, Morgan Kauffman/Elsevier, 2014.
2. Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw Hill Education, 2015.

Reference Books:

1. V. Carl Hamacher, Zvonko G. Varanasic, Safat G. Zaky, "Computer Organization", Sixth Edition, McGrawHill Inc., 2012.
2. William Stallings, "Computer Organization and Architecture", Eighth Edition, Pearson Education, 2010.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand the architecture and functionality of central processing unit	K4
CO2 :	Analyze the abstraction of various components of a computer	K4
CO3 :	Analyze the hardware and software issues and the interfacing	K3
CO4 :	Work out the trade-offs involved in designing a modern computer system	K2
CO5 :	Understand the various memory systems and I/O communication	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	2	3	2	1
CO5	3	2	2	2	1	2	3	3	1

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI144	Number of Hours/Wk	3			
Semester	IV	Max. Marks	100			
Course Category	CORE COURSE	Credit	3			
Course Title	OPERATING SYSTEM CONCEPTS			L	T	P
				3	0	0

COURSE OBJECTIVE

- To understand the fundamental concepts and role of Operating System.
- To learn the Process Management and Scheduling Algorithms
- To understand the Memory Management policies
- To gain insight on I/O and File management techniques

UNIT	TOPIC	HOURS
I	Introduction - Computer system organization- Operating System Structure and Operations-operating system services- System Calls, types of system calls-operating system structure. Processes : Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication;	9
II	Threads : Overview, Multithreading models, Threading issues; CPU Scheduling - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling;	9
III	Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. Main Memory : Background, Swapping, Contiguous Memory Allocation, Paging- Segmentation with paging. Virtual Memory – Page Replacement, Allocation, Thrashing.	9
IV	Mass Storage system – Overview of Mass Storage Structure- Disk Structure- Disk Scheduling and Management- RAID structure. File-System Interface - File concept-Access methods- Directory Structure-Directory Organization- File System Implementation - File System Structure, Directory implementation, Allocation Methods, Free Space Management- I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.	9
V	Virtual Machines : Benefits and features Types of VM and implementation- Virtualization and OS Components. Distributed Systems : Real time OS- Advantages of real time OS and distributed OS- Types of network-based Operating Systems- Network structure- Communication structure- Communication protocols.	9

TEXT BOOK:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne., (2018), "Operating System Concepts ", John Wiley and Sons Inc., 9th Edition.

REFERENCES:

1. Ramaz Elmasri, A. Gil Carrick, David Levine.,(2010), "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition.
2. Achyut S. Godbole, Atul Kahate.,(2016), "Operating Systems", McGraw Hill Education.

3. Andrew S. Tanenbaum.,(2004),”Modern Operating Systems”, Pearson Education, 2ndEdition.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand the structure, operations, and services of operating systems, including system calls and process management.	K2
CO2 :	Analyze process scheduling, multithreading models, and CPU scheduling algorithms for efficient system performance.	K4
CO3 :	Apply deadlock handling techniques such as prevention, avoidance, detection, and recovery to system resource management.	K3
CO4 :	Evaluate memory management schemes including paging, segmentation, and virtual memory to optimize system utilization.	K5
CO5 :	Analyze file systems, mass storage structures, and I/O subsystem operations to understand data management in operating systems.	K4

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	2	3	2	1
CO5	3	2	2	2	1	2	3	3	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCAI			
Course Code	25BCAI145	Number of Hours/Wk	3			
Semester	IV	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	CRYPTOGRAPHY AND NETWORK SECURITY			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- To gain insights into security principles, legal aspects, and threat mitigation strategies.
- To explore encryption techniques and their role in ensuring data confidentiality.
- To understand cryptographic algorithms and key management in secure communication.
- To analyze authentication protocols and digital security measures for integrity.
- To study real-world cybersecurity practices, including intrusion detection and firewall defense.

UNIT	TOPICS	HOURS
I	INTRODUCTION Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography) - Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.	9
II	SYMMETRIC CRYPTOGRAPHY Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclids algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution	9
III	PUBLIC KEY CRYPTOGRAPHY Mathematics Of Asymmetric Key Cryptography: Primes – Primarily Testing –Factorization – Euler ‘s totient function, Fermat ‘s and Euler ‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.	9
IV	MESSAGE AUTHENTICATION AND INTEGRITY Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics,	9

	Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509	
V	SECURITY PRACTICE AND SYSTEM SECURITY Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls	9

Text Book

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand fundamental security concepts, threats, and classical encryption techniques	K2
CO2 :	Apply symmetric and asymmetric cryptographic algorithms for secure communication	K3
CO3 :	Implement authentication mechanisms, digital signatures, and hash functions for data integrity	K3,K4
CO4 :	Analyze network and system security threats, including malware, intrusion detection, and firewalls.	K4
CO5 :	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	2	2
CO2	3	3	3	3	3	3	3	2	3
CO3	2	2	3	3	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	2	2	2	3	2	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI241	Number of Hrs/Wk	2			
Semester	IV	Max. Marks	100			
Course Category	CORE COURSE	Credit	1			
Course Title	MACHINE LEARNINGLAB			L	T	P
				0	0	2
COURSE OBJECTIVE						
<ul style="list-style-type: none"> • To practice fundamental concepts in machine learning • To introduce mathematical tools in machine learning • To introduce various framework for machine learning • To implement neural networks, CNN for applications • To implement research topic as part of ML project 						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none"> 1. Implement Least square problem, eigen value decomposition, singular value decomposition 2. Implement Linear regression and ridge regression using gradient descent and normal equation 3. Implement logistic regression with sigmoid function 4. Implement support vector machine and kernel function with KKT tools 5. Implement gaussian discriminant analysis and naïve bayes and compare the performance with different 6. datasets 7. Implement non-linear functions such as Threshold, Sigmoid, Tanh, ReLU 8. Implement multi-layer fully connected feed forward and backpropagation algorithm for training 9. Implement convolutional neural network for computer vision tasks 10. Implement research topic as part of ML project 						

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	K2
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	K3
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	K4
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	K3
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI242	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	DATABASE MANAGEMENT SYSTEMS LAB	L	T	P	
		0	0	2	

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understand and Apply SQL DDL and DML Commands
- Utilize SQL Functions and Operators Effectively
- Implement SQL Joins and Advanced Clauses
- Work with Constraints, Views, and Subqueries in SQL
- Master Database Management and PL/SQL Concepts

LIST OF EXPERIMENTS

1. DDL commands of SQL with suitable examples
 - Create table
 - Alter table
 - Drop Table
2. DML commands of SQL with suitable examples
 - Insert
 - Update
 - Delete
3. Different types of function with suitable examples
 - Number function
 - Aggregate Function
 - Character Function
 - Conversion Function
 - Date Function
4. Different types of operators in SQL
 - Arithmetic Operators
 - Logical Operators
 - Comparison Operator
 - Special Operator
 - Set Operation
5. Different types of Joins
 - Inner Join
 - Outer Join
 - Natural Join etc..
6. Study and Implementation of

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	K2
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	K3
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	K4
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	K3
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	3	2	3	3	3	3	1
CO2	3	2	2	3	3	2	3	3	2
CO3	3	2	2	3	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI243	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	Cryptography and Network Security Lab	L	T	P	
		0	0	2	

The main aim of this course is to prepare the students for:

- To gain insights into security principles, legal aspects, and threat mitigation strategies.
- To explore encryption techniques and their role in ensuring data confidentiality.
- To understand cryptographic algorithms and key management in secure communication.
- To analyze authentication protocols and digital security measures for integrity.
- To study real-world cybersecurity practices, including intrusion detection and firewall defense.

List of Experiments

1. Perform encryption, decryption using the following substitution techniques
 - i. Ceaser cipher
 - ii. Playfair cipher
 - iii. Hill Cipher
 - iv. Vigenere cipher
2. Perform encryption and decryption using following transposition techniques
 - i. Rail fence
 - ii. Row & Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
7. Calculate the message digest of a text using the SHA-1 algorithm.
8. Implement the SIGNATURE SCHEME - Digital Signature Standard.
9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any

other s/w.

10. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool

11. Defeating Malware

i. Building Trojans

ii. Rootkit Hunter

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand fundamental security concepts, threats, and classical encryption techniques	K2
CO2 :	Apply symmetric and asymmetric cryptographic algorithms for secure communication	K3
CO3 :	Implement authentication mechanisms, digital signatures, and hash functions for data integrity	K3,K4
CO4 :	Analyze network and system security threats, including malware, intrusion detection, and firewalls.	K4
CO5 :	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	2	2
CO2	3	3	3	3	3	3	3	2	3
CO3	2	2	3	3	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	2	2	2	3	2	3	3	2	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Discipline Specific Elective

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI341	Number of Hours/Wk	3			
Semester	IV	Max. Marks	100			
Course Category	Discipline Specific Elective	Credits	3			
Course Title	FULL STACK DEVELOPMENT			L	T	P
			3	0	0	
<u>COURSE OBJECTIVES</u>						
The main aim of learning this course is to:						
<ul style="list-style-type: none"> • To understand the various components of full stack development • To learn Node.js features and applications • To develop applications with MongoDB • To understand the role of Angular and Express in web applications • To develop simple web applications with React 						
UNIT	TOPICS				HOURS	
I	Basics Of Full Stack: Understanding the Basic Web Development Framework – User – Browser – Webserver – Backend Services – MVC Architecture – Understanding the different stacks –The role of Express – Angular – Node – Mongo DB – React				9	
II	Node JS: Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers – Call backs – Handling Data I/O – Implementing HTTP services in Node.js				9	
III	Mongo DB: Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications				9	
IV	Express And Angular: Implementing Express in Node.js – Configuring routes – Using Request and Response objects Angular – Typescript – Angular Components – Expressions – Data binding – Built-in directives				9	
V	React: MERN STACK – Basic React applications – React Components – React State – Express REST APIs – Modularization and Web pack – Routing with React Router – Server-side rendering				9	
<u>Text Book:</u>						
<ol style="list-style-type: none"> 1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018 2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019. 						

Reference Books

1. Full-Stack JavaScript Development by Eric Bush.
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understanding of full-stack development, including front-end, back-end, and database integration using popular technologies.	K6
C02 :	Develop practical knowledge of Node.js, including installation, using npm, creating applications, and handling asynchronous operations with events, callbacks, and timers.	K3
C03 :	Master MongoDB and NoSQL concepts, from database setup to collection management, and connecting MongoDB with Node.js applications.	K6
C04 :	Learn how to build dynamic web applications using Angular, including components, directives, data binding, and Typescript.	K6
C05 :	Acquire hands-on experience with the MERN stack to build full-stack applications with React, Express, and REST APIs, including routing and server-side rendering.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	1	3	1	2	1	3
C02	3	2	3	2	3	1	2	1	3
C03	3	3	3	2	3	2	2	1	3
C04	3	3	3	2	3	2	3	1	3
C05	3	3	3	2	3	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI342	Number of Hours/Wk	3			
Semester	IV	Max. Marks	100			
Course Category	Discipline Specific Elective	Credits	3			
Course Title	EDGE AI			L	T	P
				3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- Understand the fundamentals of AI and its execution on edge devices.
- Learn the principles and workflows of TinyML development.
- Explore hardware and software platforms used in Edge AI applications.
- Analyze model optimization techniques for deploying ML models on constrained devices.
- Implement real-time ML applications using microcontrollers and sensors.

UNIT	TOPICS	HOURS
I	Introduction to Edge AI and TinyML: Edge AI – Need for on-device intelligence – Applications of Edge AI – TinyML – TinyML vs Traditional ML – Key constraints (power, memory, latency) – Overview of Edge AI pipeline	9
II	ML Workflow and Model Building for Edge: Dataset collection – Data preprocessing – Feature engineering – Model training and evaluation – ML algorithms for Edge: Decision Trees, SVM, kNN, Tiny Neural Networks	9
III	Hardware and Software Platforms: Microcontrollers (Arduino, STM32, ESP32) – Sensor interfacing – Operating systems (FreeRTOS, TFLite Micro) – Toolchains (Edge Impulse, TensorFlow Lite, CMSIS-NN) – Edge deployment lifecycle	9
IV	Model Optimization and Deployment: Quantization, Pruning, Knowledge Distillation – Memory and compute optimization – Converting models to TFLite – Deployment using Arduino IDE, TFLite Micro runtime	9
V	Applications and Case Studies: Real-time projects: keyword spotting, gesture recognition, vibration analysis – Integrating TinyML with IoT – Power management – Privacy and security in Edge AI	9

Text Book

1. Pete Warden & Daniel Situnayake, *TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers*, O'Reilly, 2020.
2. Ajit Jaokar, *AI on the Edge: Powerful Machine Learning on Tiny Devices*, Packt Publishing, 2021.

Reference Books

1. Laurence Moroney, *AI and Machine Learning for On-Device Development*, O'Reilly, 2021.
2. Arm Education, *Machine Learning on Arm Cortex-M Microcontrollers*, Arm Education Media, 2021 Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Explain the basics of Edge AI and the need for TinyML.	K6
C02 :	Apply machine learning workflows to develop small-scale models.	K3
C03 :	Compare edge hardware platforms and deployment pipelines.	K6
C04 :	Use model compression and optimization for resource-constrained devices.	K6
C05 :	Build and test TinyML applications using real-world sensors and microcontrollers.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	3	2	2	2	2	3
C02	3	3	3	2	3	2	2	2	2
C03	3	3	2	3	2	2	3	3	2
C04	3	2	2	3	1	2	3	3	2
C05	3	2	2	2	1	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI343	Number of Hours/Wk	3			
Semester		Max. Marks	100			
Course Category	Discipline Specific Elective	Credits	3			
Course Title	SOCIAL NETWORK ANALYSIS			L	T	P
				3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- Explain the evolution of the Semantic Web, its limitations, and the role of social web platforms in network analysis.
- Apply ontology-based knowledge representation and advanced modelling techniques to social network data.
- Analyse and extract insights from web communities and study their evolution using archival data.
- Evaluate human behaviour in social networks and address privacy, trust, and reputation challenges.
- Utilize visualization techniques and graph theory to analyse and interpret social networks in practical scenarios.

UNIT	TOPICS	HOURS
I	INTRODUCTION Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web. Emergence of the Social Web – Social Network analysis: Development of Social Network. Analysis – Key concepts and measures in network analysis – Electronic sources for network.	9
II	MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Language – Modelling and aggregating social network data: State-of-the-art in network data. social relationships – Aggregating and reasoning with social network data – Advanced. Representations.	9
III	EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS: Extracting evolution of Web Community from a Series of Web Archive – Detecting.	9
IV	VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based. representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.	9
V	PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES Understanding and predicting human behaviour for social communities – User data management.– Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining Trust and reputation – Trust derivation based on trust comparisons.	9

Text Books:

1. Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL, **Authors:** Dean Allemang, James Hendle, **Publisher:** Morgan Kaufmann, Edition: 2nd Edition (2011)

Reference Books:

1. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management, **Authors:** Tim Berners-Lee, James Hendler, Ora Lassila, **Publisher:** Morgan Kaufmann, **Edition:** 1st Edition (2001)

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Illustrate the Evolution of the Semantic Web and Social Web Platforms	K6
CO2 :	Apply Ontology-Based Knowledge Representation and Modeling Techniques	K3
CO3 :	Extract Insights from Web Communities and Evaluate Evolution	K6
CO4 :	Assess Human Behavior and Address Privacy, Trust, and Reputation Challenges	K6
CO5 :	Employ Graph Theory and Visualization Techniques for Social Network Analysis	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	2	1	2
CO2	3	3	3	2	3	2	3	3	3
CO3	2	3	3	3	3	2	3	3	3
CO4	3	2	2	3	2	2	3	2	2
CO5	3	3	3	2	3	3	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

SEMESTER- V

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI151	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	DEEP LEARNING		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of learning this course is to:

- Understand the principles of deep learning and neural network architecture.
- Design, train, and evaluate deep learning models for various applications such as image classification, speech recognition, and NLP.
- Implement advanced deep learning techniques like CNNs, RNNs, and GANs.
- Optimize and regularize deep learning models to prevent overfitting and enhance generalization.
- Apply deep learning methods to solve real-world problems in computer vision, NLP, and other domains.

UNIT	TOPICS	HOURS
I	Introduction to Deep Learning Mathematical building blocks of neural network-neural network Introduction to Neural Networks-Overview of machine learning and deep learning-Perceptron model and neural networks- Activation functions.Deep Learning Frameworks-Overview of frameworks: TensorFlow, Keras, PyTorch-Setting up the environment and tools for deep learning	9
II	Foundations of Deep Neural Networks (DNNs) Feedforward Neural Networks-Architecture of feedforward neural networks (FNNs)-Backpropagation and gradient descent-Loss functions and optimization algorithms . Training Neural Networks- Overfitting, underfitting, and regularization-Batch normalization and learning rate scheduling	9
III	Convolutional Neural Networks (CNNs) Introduction to CNNs-Convolutional layers, pooling layers, and fully connected layers-CNN architectures. Applications of CNNs- Image classification, object detection, and segmentation-Transfer learning using pre-trained models. Advanced CNN Techniques- Data augmentation, fine-tuning, and model ensembling	9
IV	Recurrent Neural Networks (RNNs) Introduction to RNNs-RNN architecture and vanishing gradient problem-Long Short-Term Memory and Gated Recurrent Units.- Applications of RNNs-Sequence prediction, language modeling,	9

	and sentiment analysis-Time-series forecasting, speech recognition.	
V	Generative Models (GANs, VAEs) Generative Adversarial Networks (GANs)-Architecture of GANs-Training GANs and applications. Variational Autoencoders (VAEs)-Introduction to VAEs and their use in unsupervised learning. Multi-modal Deep Learning-Combining vision, speech, and text in a unified model-Applications in autonomous driving, robotics, and healthcare	9

Text Books:

1. **Deep Learning with Python** by François Chollet,Publisher: Manning, ISBN: 978-1617294433
2. **Deep Learning** by Ian Goodfellow, Yoshua Bengio, and Aaron Courville,Publisher: MIT Press, ISBN: 978-0262035613
3. **Neural Networks and Deep Learning: A Textbook** by Charu Aggarwal,Publisher: Springer, ISBN: 978-3319944623

Reference Books:

1. **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow** by Aurélien Géron,Publisher: O'Reilly Media, ISBN: 978-1492032649
2. **Deep Learning for Computer Vision** by Rajalingappaa Shanmugamani,Publisher: Apress, ISBN: 978-1484229577
3. **Pattern Recognition and Machine Learning** by Christopher Bishop,Publisher: Springer, ISBN: 978-0387310732

Websites for Learning & Tools:

1. **TensorFlow**
 - Website: <https://www.tensorflow.org/>
 - A popular deep learning framework for building and training neural networks.
2. **Keras**
 - Website: <https://keras.io/>
 - A high-level neural networks API, written in Python, running on top of TensorFlow.
3. **PyTorch**
 - Website: <https://pytorch.org/>
 - An open-source deep learning framework widely used in both research and industry.
4. **Fast.ai**
 - Website: <https://www.fast.ai/>

- A research group that provides practical deep learning tutorials and libraries based on PyTorch.

5. Kaggle

- Website: <https://www.kaggle.com/>
- A platform for machine learning competitions with datasets and kernels, including many deep learning challenges.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	To introduce the foundational concepts of deep learning, including neural networks, activation functions, and optimization techniques.	K2
C02 :	To explore various deep learning architectures such as feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs).	K2
C03 :	To study advanced topics like generative adversarial networks (GANs), transfer learning, and deep reinforcement learning.	K3
C04 :	To provide hands-on experience in implementing deep learning models for real-world applications in computer vision, natural language processing (NLP), and speech recognition.	K4
C05 :	To emphasize model evaluation, regularization techniques, and strategies for improving the efficiency and scalability of deep learning models.	K

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	3	2	3	2	3	3	2	-
C02	3	3	3	3	3	3	3	2	2
C03	3	3	3	3	3	3	3	3	2
C04	3	3	3	3	3	3	3	3	3
C05	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI162	Number of Hours/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	Web Technology			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main learning objectives of this course are to prepare students to:

1. **Understand Web Basics and Frontend Development:** Learn the fundamentals of web technologies, including HTML5, CSS3, and Bootstrap, for creating interactive and responsive web designs.
2. **Develop Client-side Programming Skills:** Gain proficiency in JavaScript, including DOM manipulation, event handling, and JSON, to create dynamic web content.
3. **Master Server-side Programming:** Understand Java Servlets, their life cycle, session management, cookies, and database connectivity using JDBC for backend development.
4. **Explore PHP and XML for Web Development:** Learn PHP programming for server-side scripting and understand XML for data representation, validation, and transformations.
5. **Introduce Modern Web Frameworks and Tools:** Gain insights into AngularJS, MVC architecture, and modern web frameworks like React, Node.js, and Django, along with tools like Firebase and Docker for building scalable web applications.

UNIT	TOPICS	HOURS
I	WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0 Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP.Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables– Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3– Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds –Border Images – Colours – Shadows – Text – Transformations – Transitions Animations.Bootstrap Framework	9
II	CLIENT SIDE PROGRAMMING Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling Validation- Built-in objects-Event Handling- DHTML with JavaScript-JSON introduction –Syntax – Function Files.	9
III	SERVER SIDE PROGRAMMING Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC. 121	9
IV	PHP and XML An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL ,	9
V	INTRODUCTION TO ANGULAR and WEB APPLICATIONS FRAMEWORKS	9

	Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase-Docker- Node JSReact- Django- UI & UX.	
Text Books:		
<ol style="list-style-type: none"> 1. Anil Mahesh Wari, "Data Analytics made accessible," Amazon Digital Publication, 2014. 2. James R. Evans, "Business Analytics: Methods, Models, and Decisions", Pearson 2012. 3. Song, Peter X. K, "Correlated Data Analysis: Modeling, Analytics, and Applications", Springer-Verlag New York 2007. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining", Wiley 2009. 2. Thomas H. Davenport, Jeanne G. Harris and Robert Morison, "Analytics at Work: Smarter Decisions, Better Results", Harvard Business Press, 2010. 		

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Design and develop responsive web applications using HTML5, CSS3, and Bootstrap	K6
CO2 :	Implement dynamic client-side functionalities using JavaScript, including DOM manipulation and JSON data handling.	K3
CO3 :	Develop server-side applications using Java Servlets with session management, cookies, and JDBC database connectivity.	K6
CO4 :	Build server-side scripts using PHP and utilize XML for data representation, validation, and transformation	K6
CO5 :	Apply modern web frameworks like AngularJS, React, and Django, and use tools like Firebase and Docker for scalable web application development.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	3	2	2
CO2	3	3	2	2	3	2	3	2	3
CO3	3	3	3	2	3	3	2	3	3
CO4	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI153	Number of Hrs/Wk	4			
Semester	V	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	THEORY OF COMPUTATION			L	T	P
				3	1	0
<p>COURSE OBJECTIVES: The main learning objective of this course is to prepare the students:</p> <ul style="list-style-type: none"> To give an overview of the theoretical foundations of computer science from the perspective of formal languages. To illustrate finite state machines to solve problems in computing To familiarize Regular grammars and Context Free Grammar. To solve various problems by normal form techniques, Push Down Automata and Turing Machines. 						
UNIT	UNIT				HOURS	
I	<p>Introduction-Finite Automata Introduction to Computation and Formal Languages- Syntax and Semantics- Finite Automata- Alphabets - Strings and Languages - Automata and Grammars - Deterministic Finite Automata (DFA) - Formal Definition - Simplified notation: State transition graph - Transition table - Language of DFA - Nondeterministic Finite Automata (NFA) - NFA with epsilon transition - Language of NFA - Equivalence of NFA and DFA - Minimization of Finite Automata - Distinguishing one string from other - Myhill-Nerode Theorem.</p>				9	
II	<p>Regular Expression (RE) Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleen's Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.</p>				9	
III	<p>Context Free Grammar (CFG) and Context Free Languages Definition - Examples - Derivation - Derivation trees - Ambiguity in Grammar - Inherent ambiguity - Ambiguous to Unambiguous CFG - Useless symbols - Simplification of CFGs - Normal forms for CFGs: CNF and GNF - Closure properties of CFLs - Decision Properties of CFLs: Emptiness - Finiteness and Membership - Pumping lemma for CFLs.</p>				9	
IV	<p>Push Down Automata (PDA)</p>				9	

	Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.	
V	Turing Machines (TM) and Undecidability Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Church's Thesis - Recursive and recursively enumerable languages - Halting problem - Introduction to Undecidability - Undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of post correspondence problem - Introduction to recursive function theory.	9
<p><u>Text Book:</u></p> <ol style="list-style-type: none"> 1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education, India, 2007 <p><u>Reference Books:</u></p> <ol style="list-style-type: none"> 1. K. L. P Mishra, N. Chandrashekar, Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India, 2003 		

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Design finite automata or regular expression for any tokenization task	K2
CO2 :	Construct a context free grammar for parsing any language	K2
CO3 :	Design Turing machine for any language	K2
CO4 :	Conclude the decidable / undecidable nature of any language	K4
CO5 :	Apply mathematical and formal techniques for solving real-world problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	1	2	2	3	2	1
C02	2	3	2	1	3	2	2	3	2
C03	3	2	3	2	2	3	3	2	2
C04	2	3	2	3	2	1	2	1	3
C05	1	1	2	3	1	2	1	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI154	Number of Hrs/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	SOFTWARE ENGINEERING			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- Understand the nature of the software
- Understand the different types of process models, agile developments and aspects of software engineer
- Gain knowledge about the requirements stage and development of the software
- Analyze the different types of architectural designs of the software
- Evaluate different testing strategies of the software and Develop the software

UNIT	TOPICS	HOURS
I	The Nature of Software - Software Engineering - Software Process.	9
II	Process Models: Prescriptive Process Models - Agile Development - Human Aspects of Software Engineering	9
III	Understanding Requirements: Requirements Engineering - Establishing the Groundwork Building the Analysis Model - Negotiating Requirements Requirements Modeling: Scenario-Based Methods: Requirements Analysis - Scenario-Based Modeling	9
IV	Design Concepts: Design within the Context of Software Engineering - The Design Process - Design Concepts Architectural Design: Software Architecture - Architectural Genres - Architectural Styles - Architectural Considerations - Architectural Decisions - Architectural Design	9
V	User Interface Design: The Golden Rules - User Interface Analysis and Design - Interface Analysis - Interface Design Steps - WebApp and Mobile Interface Design - Design Evaluation. Software Testing Strategies - Software Testing Fundamentals. Maintenance and Reengineering.	9

Text Book

1. Roger S Pressman, "Software Engineering a Practitioner's Approach", 9th Edition, McGraw-Hill Higher Education, 2023.

Reference Books

1. Richard E.Fairly (2005),"Software Engineering" Concepts, Tata Mc Graw Hill Book Company.
2. Jawadkar (2004), "Software Engineering" ,Tata Mc Graw-Hill Book Company.

3. Dr. Richard Hall Thayer and Dr. Merlin Dorfman(2012),“Software Engineering Essentials, Volume I: The Development Process”, Software Management Training; Fourth edition,.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand the nature of the software	K2
C02 :	Understand the different types of process models, agile developments and aspects of software engineer	K2
C03 :	Gain knowledge about the requirements stage and development of the software	K2
C04 :	Analyze the different types of architectural designs of the software	K4
C05 :	Evaluate different testing strategies of the software and Develop the software	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	3	2	1	3	-	3	2	-
C02	3	3	3	2	3	-	3	3	2
C03	3	3	3	3	3	2	3	3	2
C04	3	3	3	3	3	-	3	3	3
C05	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI155	Number of Hrs/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	INTERNET OF THINGS			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- To understand the fundamentals, applications, and challenges of IoT.
- To explore IoT system design, architecture, and embedded systems.
- To analyze IoT communication protocols and networking techniques.
- To study IoT data analytics, cloud integration, and machine learning applications.
- To examine real-world IoT applications, security challenges, and future trends..

UNIT	TOPICS	HOURS
I	Introduction to to IoT: Basics of IoT – IoT Characteristics – IoT Applications – Challenges in IoT – Smart Homes – Healthcare – Agriculture – Industrial IoT – Security and Privacy in IoT – Best Practices in IoT System Design.	9
II	IoT Architecture & Design Methodology: IoT System Design – IoT Architecture Layers – Embedded Systems for IoT – Sensors & Actuators – Interfacing Techniques – Power Management in IoT Devices.	9
III	IoT Communication & Networking: Wireless Communication Protocols – Bluetooth – Wi-Fi – Zigbee – LoRa – 5G – IoT Protocol Stack – MQTT – CoAP – Data Transmission in IoT – Designing Low-Power and Scalable IoT Networks – Edge and Fog Computing.	9
IV	IoT Data Analytics & Cloud Integration: Data Collection & Storage – Cloud Computing for IoT – AWS IoT – IBM Watson – Google Cloud IoT – IoT Data Processing – AI & Machine Learning in IoT – Data Encryption & Secure Storage Methods.	9
V	IoT Applications & Case Studies: IoT in Smart Cities – IoT in Healthcare – Predictive Maintenance – IoT-Based Automation – Security & Ethical Issues in IoT – Legal and Privacy Considerations – Future Trends in IoT.	9

Text book:

1. Internet of Things for Architects, Perry Lea, Packt Publishing, 2018.

References:

1. Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry”, Maciej Kranz, Wiley, 2016.
2. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, 2013.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Define IoT fundamentals, classify IoT characteristics, and analyze security aspects.	K2
C02 :	Develop IoT systems, integrate embedded components, and configure sensors and actuators.	K2
C03 :	Implement IoT communication protocols, analyze networking techniques, and demonstrate their applications.	K2
C04 :	Deploy IoT solutions on cloud platforms, process IoT data, and assess system performance.	K4
C05 :	Compare IoT applications, assess security risks, and justify ethical considerations.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	3	2	2	3	2	3	2	3
C02	3	3	3	3	3	2	3	3	3
C03	3	3	3	3	3	2	3	3	3
C04	3	3	3	3	3	2	3	3	3
C05	3	3	2	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI251	Number of Hours/Wk	2			
Semester	V	Max. Marks	100			
Course Category	CORE COURSE	Credits	1			
Course Title	DEEP LEARNING LAB			L	T	P
				0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- Understand the principles of deep learning and neural network architecture.
- Design, train, and evaluate deep learning models for various applications such as image classification, speech recognition, and NLP.
- Implement advanced deep learning techniques like CNNs, RNNs, and GANs.
- Optimize and regularize deep learning models to prevent overfitting and enhance generalization.
- Apply deep learning methods to solve real-world problems in computer vision, NLP, and other domains.

LIST OF PROGRAMS

Unit I: Mathematical Building Blocks and Neural Networks

1. **Implement basic matrix operations and their application in neural networks.**
 - Perform operations like dot product, matrix multiplication, and transpose.
 - Use NumPy for efficient computation.
2. **Build a perceptron model for binary classification.**
 - Implement a single-layer neural network using Python.
 - Train it on a simple dataset like OR, AND, or XOR.
3. **Visualize activation functions (Sigmoid, ReLU, Tanh, Softmax).**
 - Plot the functions and demonstrate their outputs for a range of inputs.
4. **Set up a deep learning environment.**
 - Install and configure TensorFlow, Keras, and PyTorch.
 - Verify the setup by running a simple "Hello World" program using each framework.

Unit II: Foundations of Deep Neural Networks

5. **Implement a feedforward neural network (FNN).**
 - Use TensorFlow/Keras to create a simple FNN for MNIST digit classification.
6. **Backpropagation and gradient descent implementation.**
 - Write a Python program to implement backpropagation for a basic FNN.
 - Visualize the loss reduction over epochs.
7. **Demonstrate L1 and L2 regularization.**
 - Train a neural network on a small dataset and showcase the effects of L1/L2 regularization.
8. **Apply batch normalization.**

- Train a network with and without batch normalization to observe its impact on convergence.
-

Unit III: Convolutional Neural Networks (CNNs)

- 9. Build and train a simple CNN.**
 - Implement a CNN for image classification using the CIFAR-10 dataset.
 - 10. Experiment with different CNN architectures.**
 - Use pre-defined architectures like LeNet, AlexNet, and VGG.
 - 11. Perform image classification using transfer learning.**
 - Use a pre-trained model (e.g., ResNet or Inception) and fine-tune it on a custom dataset.
 - 12. Apply data augmentation techniques.**
 - Augment an image dataset using rotation, flipping, zooming, etc., and retrain a CNN.
-

Unit IV: Recurrent Neural Networks (RNNs)

- 13. Implement a simple RNN for sequence prediction.**
 - Use a dataset like sine wave data to predict the next value in a sequence.
 - 14. Train an LSTM model for text generation.**
 - Use a text corpus to generate text using LSTM.
 - 15. Perform sentiment analysis.**
 - Train a GRU-based model on a dataset like IMDB reviews.
 - 16. Time-series forecasting using LSTM.**
 - Use a dataset like stock prices or weather data for time-series prediction.
-

Unit V: Generative Models (GANs, VAEs, and Multi-modal Learning)

- 17. Build a simple Generative Adversarial Network (GAN).**
 - Generate synthetic data (e.g., handwritten digits) using GAN.
 - 18. Implement a Variational Autoencoder (VAE).**
 - Train a VAE on the MNIST dataset and visualize the latent space.
 - 19. Perform image-to-image translation.**
 - Use a GAN model like CycleGAN to convert images from one domain to another (e.g., photos to sketches).
 - 20. Combine vision and text using multi-modal deep learning.**
 - Build a model that classifies images based on accompanying captions (e.g., using MS-COCO dataset).
-

Additional Exercises

- Explore optimization algorithms (SGD, Adam, RMSprop) and compare their performance on the same dataset.

Evaluate models for overfitting and implement dropout regularization.

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	To introduce the foundational concepts of deep learning, including neural networks, activation functions, and optimization techniques.	K2
C02 :	To explore various deep learning architectures such as feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs).	K2
C03 :	To study advanced topics like generative adversarial networks (GANs), transfer learning, and deep reinforcement learning.	K3
C04 :	To provide hands-on experience in implementing deep learning models for real-world applications in computer vision, natural language processing (NLP), and speech recognition.	K4
C05 :	To emphasize model evaluation, regularization techniques, and strategies for improving the efficiency and scalability of deep learning models.	K

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	3	2	3	2	3	3	2	-
C02	3	3	3	3	3	3	3	2	2
C03	3	3	3	3	3	3	3	3	2
C04	3	3	3	3	3	3	3	3	3
C05	3	3	3	3	3	3	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI252	Number of Hours/Wk	2		
Semester	VI	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	Web Technology Lab		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objectives of this course are to prepare students to:

- **Understand Web Basics and Frontend Development:** Learn the fundamentals of web technologies, including HTML5, CSS3, and Bootstrap, for creating interactive and responsive web designs.
- **Develop Client-side Programming Skills:** Gain proficiency in JavaScript, including DOM manipulation, event handling, and JSON, to create dynamic web content.
- **Master Server-side Programming:** Understand Java Servlets, their life cycle, session management, cookies, and database connectivity using JDBC for backend development.
- **Explore PHP and XML for Web Development:** Learn PHP programming for server-side scripting and understand XML for data representation, validation, and transformations

List of Experiments

1. Write a HTML program for the demonstration of Lists.
2. Write a HTML program for demonstrating Hyperlinks.
3. Write a HTML program for time-table using tables.
4. Write a HTML program to develop a static Home Page using frames.
5. Write a HTML program to develop a static Registration Form.
6. Write a HTML program to develop a static Login Page.
7. Write a HTML program to develop a static Web Page for Catalog.
8. Write a HTML program to develop a static Web Page for Shopping Cart.
9. Write a javascript program to validate USER LOGIN page.
10. Write a javascript program for validating REGISTRATION FORM
11. Write a program for implementing XML document for CUSTOMER DETAILS.
12. Write an internal Document Type Definition to validate XML for CUSTOMER DETAILS?
13. Write an external Document Type Definition to validate XML for CUSTOMER DETAILS?
14. Write an XML for person information and access the data using XSL.
15. Write an XML for student information and access second students data using DOM.
16. Write a program to display contents of XML file in a table using Extensible Style Sheets.

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Design and develop responsive web applications using HTML5, CSS3, and Bootstrap	K6
C02 :	Implement dynamic client-side functionalities using JavaScript, including DOM manipulation and JSON data handling.	K3
C03 :	Develop server-side applications using Java Servlets with session management, cookies, and JDBC database connectivity.	K6
C04 :	Build server-side scripts using PHP and utilize XML for data representation, validation, and transformation	K6
C05 :	Apply modern web frameworks like AngularJS, React, and Django, and use tools like Firebase and Docker for scalable web application development.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	2	2	1	3	2	2
C02	3	3	2	2	3	2	3	2	3
C03	3	3	3	2	3	3	2	3	3
C04	3	3	2	3	3	3	3	3	3
C05	3	3	3	3	3	3	3	2	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Discipline Specific Elective

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI351	Number of Hours/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Discipline Specific Elective	Credits	3			
Course Title	CLOUD SECURITY			L	T	P
				3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- Understand the architecture, models, and benefits of cloud computing
- Learn about compliance, auditing, and risk management in cloud security
- Explore data security measures, including encryption and key management
- Gain knowledge of identity management, virtualization, and secure cloud operations.

UNIT	TOPICS	HOURS
I	Cloud Computing Architecture and Security Framework Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi- Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated.	9
II	Cloud Computing: Compliance, Audit, Portability, and Interoperability Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing providers reasons, Changing providers expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions.	9
III	Cloud Security and Risk Management Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP).	9
IV	Cloud Computing Security: Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, Recommendations.	9
V	Cloud Security Framework Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS, IDaaS Security Recommendations. Virtualization: Hardware Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations.	9

Text Book

1. Dhillon, V., Metcalf, D., and Hooper, M, Blockchain enabled applications, 2017, 1st Proceedings of the 65th Academic Council (17.03.2022) 1042 Edition, CA: Apress, Berkeley.
2. Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions" by Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, and Michael Wuehler

3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Agenda Item 65/39 - Annexure - 35 Proceedings of the 65th Academic Council (17.03.2022) 1047 Bitcoin and cryptocurrency technologies: a comprehensive introduction, 2016, Princeton University Press

Reference Books

1. Diedrich, H., "Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations", 2016, 1st Edition, Wildfire publishing, Sydney
2. Cryptography and Network Security: Principles and Practices, William Stallings, 7th edition, 2017
3. Bashir, I., "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", 2nd Edition, Packt Publishing Ltd, March 30, 2018.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand the fundamental architecture of cloud computing, including cloud deployment models, service models, and essential characteristics	K6
C02 :	Analyze cloud security challenges and integrate security measures into the cloud computing framework	K3
C03 :	Examine the importance of compliance, audit, portability, and interoperability in cloud environments.	K6
C04 :	Explore risk management practices, business continuity, and disaster recovery strategies within cloud computing.	K6
C05 :	Learn encryption techniques, key management lifecycle, and security standards to ensure data confidentiality and integrity in the cloud.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	2	3	2	3	2	2
C02	3	3	2	3	3	2	3	3	2
C03	3	3	3	3	3	3	3	3	3
C04	3	2	3	3	3	3	3	3	3
C05	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCAI			
Course Code	25BCAI352	Number of Hours/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Discipline Specific Elective	Credits	3			
Course Title	CLOUD COMPUTING			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main aim of learning this course is to:						
<ul style="list-style-type: none"> To understand the fundamental concepts, architecture, and services of cloud computing. To explore cloud models, virtualization techniques, and cloud infrastructure. To analyze cloud storage, data management, and security challenges. To examine cloud platforms, service and case studies. 						
UNIT	TOPIC				HOURS	
I	Introduction to Cloud Computing: Vision of Cloud Computing – Cloud Computing Reference Model – Characteristics and Benefits – Challenges Ahead – Evolution and Historical Developments – Distributed Systems – Virtualization – Building Cloud Environments – Application and Infrastructure Development – Cloud Computing Platforms – Parallel vs. Distributed Computing – Elements of Parallel Computing – Hardware Architectures for Parallel Processing – Parallel Programming Approaches.				10	
II	Cloud Models and Virtualization: Cloud Computing Reference Model – Types of Clouds (Public, Private, Hybrid, Community) – Economics of Cloud Computing – Virtualization Basics – Characteristics of Virtualized Environments – Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing – Advantages and Disadvantages of Virtualization – Technology Example: VMware Full Virtualization.				9	
III	Cloud Platforms and Parallel Computing: Aneka Cloud Platform – Anatomy of Aneka Container – Introducing Parallelism in Cloud – Multithreading in Aneka – Developing Parallel Applications in Aneka – Cloud Computing Economics – Cloud Infrastructure Cost Analysis – Economics of Private vs. Public Clouds – Software Productivity in Cloud – Economies of Scale in Cloud Deployments.				9	
IV	Cloud Storage and Data Management: Multi-Tenancy and Multi-Schema Approaches – Data Access Control for Enterprise Applications – Cloud Data Management – Cloud File Systems (GFS, HDFS) – NoSQL Databases (BigTable, HBase) – Cloud Data Stores (Google Datastore, Amazon SimpleDB) – Challenges in Cloud Data Security.				9	
V	Cloud Service Providers and Case Studies: Amazon Web Services (AWS) – Compute Services (EC2, Lambda) – Storage Services (S3, Glacier) – Communication Services (SNS, SQS) – Additional AWS Services. Microsoft Azure – Azure Core Concepts – SQL Azure – Windows Azure Platform Appliance.				8	

Text book:

2. "Mastering Cloud Computing: Foundations and Applications Programming", Rajkumar Buyya, Christian Vecchiola, & Thamarai Selvi, McGraw Hill, 2013.
3. "Cloud Computing: Concepts, Technology & Architecture", Thomas Erl, Zaigham Mahmood, & Ricardo Puttini, Pearson, 2013.

References:

3. "Cloud Computing: A Practical Approach", Anthony T. Velte, Toby J. Velte, & Robert Elsenpeter, McGraw Hill, 2010.
4. "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", George Reese, O'Reilly Media, 2009.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Define cloud computing fundamentals, classify cloud architectures, and illustrate its benefits.	K6
C02 :	Differentiate cloud models, analyze virtualization techniques, and assess their impact on cloud environments.	K3
C03 :	Implement parallel computing concepts, measure performance, and evaluate cloud infrastructure cost-effectiveness.	K6
C04 :	Examine cloud storage mechanisms, investigate data management techniques, and assess security challenges in distributed cloud environments.	K6
C05 :	Contrast cloud service providers, analyze their features, and justify the selection of cloud computing solutions for real-world applications.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	3	3	0	3	2	3
C02	3	3	2	3	3	0	3	3	3
C03	3	3	3	3	3	2	3	3	3
C04	3	3	3	3	3	2	3	3	3
C05	3	2	1	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCAI		
Course Code	25BCAI353	Number of Hours/Wk	3		
Semester		Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	FUZZY LOGIC AND APPLICATIONS		L	T	P
			3	0	0
COURSE OBJECTIVES					
<ul style="list-style-type: none"> • To understand the principles of fuzzy logic and its applications in real-world scenarios. • To develop skills in fuzzy inference, approximate reasoning, and decision-making. • To explore the integration of fuzzy logic with optimization and AI techniques. • To apply fuzzy systems in various domains such as image processing, robotics, and control systems. 					
UNIT	TOPI				HOURS
I	Introduction to Fuzzy Logic: Introduction to Fuzzy Logic - Classical vs. Fuzzy Sets - Membership Functions - Set Operations - Fuzzy Relations - Properties of Fuzzy Sets - Applications of Fuzzy Sets in Decision-Making.				8
II	Fuzzy Logic Systems and Approximate Reasoning: Fuzzy If-Then Rules - Linguistic Variables - Approximate Reasoning - Fuzzy Rule-Based Systems - Mamdani vs. Sugeno Models - Fuzzy Decision-Making.				8
III	Fuzzification and Defuzzification Techniques: Need for Fuzzification - Membership Function Selection - Methods of Defuzzification - Centroid, Mean of Maximum (MoM), and Weighted Average Techniques - Case Studies in Control Systems.				8
IV	Fuzzy Systems in Optimization and Hybrid AI Models: Fuzzy Clustering (Fuzzy C-Means) - Genetic Algorithms in Fuzzy Optimization - Hybrid Systems (Fuzzy + Neural Networks, Fuzzy + Evolutionary Computing) - Adaptive Neuro-Fuzzy Inference Systems (ANFIS).				1 1
V	Applications of Fuzzy Logic: - Fuzzy Logic in Pattern Recognition - Fuzzy-Based Image Processing - Fuzzy Control Systems - Fuzzy Expert Systems - AI and Machine Learning Applications - Case Studies in Engineering and Industry.				10

Text book:

1. Fuzzy logic with engineering applications, Ross, T. J., John Wiley and Sons, 2005.
2. Neuro-Fuzzy and Soft Computing”, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall, 1997.
3. Fuzzy Sets and Fuzzy Logic: Theory and Applications”, Klir, G. J., & Yuan, B., Prentice Hall, 1995

References:

1. Uncertain Rule-Based Fuzzy Systems: Introduction and New Directions”, Mendel, J. M., Springer, 2nd Edition, 2017.
2. Fuzzy Sets and Applications”, Zimmermann, H. J., Springer, 2010.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Define the principles of fuzzy logic and classify fuzzy set operations.	K6
C02 :	Compare fuzzy inference mechanisms and demonstrate approximate reasoning methods.	K3
C03 :	Implement fuzzification and defuzzification techniques in fuzzy logic systems.	K6
C04 :	Analyze fuzzy optimization methods and construct hybrid AI models.	K6
C05 :	Evaluate fuzzy logic applications in control systems, pattern recognition, and AI.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	2	2	3	1	3	2	3
C02	3	3	3	2	3	1	3	3	3
C03	3	3	3	3	3	2	3	3	3
C04	3	3	3	3	3	2	3	3	3
C05	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCAI			
Course Code	25BCAI354	Number of Hours/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Discipline Specific Elective	Credits	3			
Course Title	Introduction to Machine Learning			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To explore fundamental concepts in machine learning
- To equip different concepts in machine learning with mathematical intuition
- To construct an existing problem into standard machine learning paradigm
- To develop an innovative ML model for research problems using different ML tools and standard datasets

UNIT	TOPIC	HOURS
I	Introduction to machine learning Introduction to machine learning; Mathematics behind machine learning; Linear algebra - Vector space, system of linear equations, projection, Solving $Ax=b$, projection, least square problem, eigen values and vectors, eigen decomposition, singular value decomposition; Probability - expectation, variance, covariance; Multivariable calculus basics;	8
II	Linear and Logistic Regression Linear Regression - cost function, optimization function; gradient descent - batch, mini-batch, stochastic; normal equation; regularization -ridge regression; feature scaling; logistic regression - sigmoid function, solving cost function; maximum likelihood estimation; gaussian discriminant analysis; naïve bayes;	8
III	SVM and Bayesian learning Support vector machine - linear discriminant analysis, KKT theorem, primal-dual problem; Kernels - polynomial, gaussian; decision trees - information gain, gini index; Bayesian learning - bayes minimum risk classifier; multivariate normal distribution; softmax classifier; Non-linear functions - threshold, sigmoid, ReLU, tanh;	8
IV	Neural Networks and CNN Neural networks; perceptron; multilayer perceptron; backpropagation algorithm; autoencoder - deep autoencoder, sparse auto encoder, denoising autoencoder; convolution; convolutional neural network - pooling, padding, strided convolution; CNN example - LeNet, AlexNet, VGGNet, ResNeT GoogleNet;	11

V	Clustering and Dictionary learning Clustering – K-means, K-medoids; issues in deep learning – vanishing/exploding gradient problem, overfitting, covariate shift; momentum optimizer; Nesterov accelerated gradient; adagrad; RMS prob; ada delta; underdetermined system of linear equations; pursuit algorithms; sparse coding; dictionary learning;	10
Text Books: 1.Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016. 2.Andrew Ng. Machine Learning Yearning. deeplearning.ai, 2018. Reference Books: 1.Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016. 2.M. Elad, Sparse and Redundant Representations: From Theory to Applications in Signal and Image Processing, Springer, 2010.		

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Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Infers mathematical concepts behind machine learning	K6
CO2 :	Distinguish different ML concepts in terms of applications	K3
CO3 :	Implement standard ML algorithms for applications	K6
CO4 :	Validate the ML models to improve the performance	K6
CO5 :	Develop an ML model for existing problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	3	2	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Open Elective

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI051	Number of Hours/Wk	3			
Semester	V	Max. Marks	100			
Course Category	Open Elective	Credits	3			
Course Title	ARTIFICIAL INTELLIGENCE			L	T	P
				3	0	0
<u>COURSE OBJECTIVES</u>						
<p>The main aim of learning this course is to:</p> <ul style="list-style-type: none"> • To explore history and revolution of artificial intelligence • To formulate artificial intelligence problem by defining intelligent agent and its environment • To learn problem solving approaches through state space search and its different algorithms. • To develop an AI model with the help of concepts such as state space search, adversarial search, knowledge representation, inference etc. 						
UNIT	TOPICS				HOURS	
I	Introduction to AI Introducing the structure and scope of the course; Introduction and History of AI; Turing Test; Chinese Room Argument; Milestones in AI; AI Project Discussion – Problem finding, Project resources, Report writing; Intelligent agent – Sensors and Actuators; Examples of Agents; Rationality – perfect and bounded rationality;				9	
II	Intelligent agent and state space search Intelligent agent and its environment; Types of environments; Multi- agent environment; Structure of the agent – table based agent, percept based agent, state based agent, goal based agent, utility based agent; Subsumption architecture; Learning agent; State and State space definition; State space search; Problem formulation; 8 Queens problem; 8 Puzzle problem; Problem formulation examples;				9	
III	Uninformed and Informed Searches Uninformed search – Breadth first search, Depth first search, Depth limited search, Iterative deepening search, Bidirectional search, Uniform cost search; Informed Search – Greedy best first search, A* search, Memory-bounded search; Heuristic function;				9	
IV	Local search and adversarial search Search in complex environment; Local search and optimization problems; Hill-climbing search; Simulated annealing; Local beam search; Adversarial search; Game theory – Two-player zero-sum games – max and min, utility function, state space graph, game tree, tic-tac-toe example; Minimax search; Alpha-Beta pruning;				9	
V	Constraint satisfaction and Knowledge representation Constraint satisfaction problem; satisfiability; propagating constraints; forward checking; backward checking; Knowledge representation – Logic, Propositional logic, Reasoning, Modus Ponens; First order logic; quantifiers; Mathematics behind machine learning – Linear algebra basics				9	

Text Books:

2. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009

Reference Books:

3. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
4. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.

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Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Describe the history behind artificial intelligence	K6
C02 :	Illustrate fundamental AI concepts	K3
C03 :	Demonstrate problem formulation in state space search	K6
C04 :	Infers adversarial search with alpha-beta pruning	K6
C05 :	Develop an AI model for existing problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	1	2	1	0	0	1	2	0	0
C02	3	2	3	3	0	2	0	3	3
C03	3	1	2	2	0	2	1	1	3
C04	3	1	2	2	0	2	0	1	2
C05	2	2	3	3	3	1	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI052	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Course Category	Open Elective	Credits	3			
Course Title	PYTHON PROGRAMMING			L	T	P
			3	0	0	
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> To Understand the fundamentals of the Python programming language and its historical development To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation. To demonstrate object oriented concept in python To familiarize with machine learning tools in python 						
UNIT	TOPICS				HOURS	
I	Introduction to python programming Introduction to python ; setting up python programming environment; variables; strings and its operations; special characters; stripping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice;				9	
II	Python datatypes Tuples and its operations; relational operators; conditional statements – if, if-else, if-elif-else; multiple conditional blocks; dictionaries; key-value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting;				9	
III	Loop and function While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module;				9	
IV	OOPs in python Classes; __init__() method; instance of a class; accessing attributes; calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block;				9	
V	Python machine learning tools Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python based machine learning libraries – pytorch, tensorflow; virtual environment; machine learning application using python tools;				9	
Text Book						
2. Matthes, Eric. <i>Python Crash Course: A Hands-On, Project-Based Introduction to Programming</i> . 2nd ed., No Starch Press, Inc., 2019.						
Reference Book						
2. Sweigart, Al. <i>Automate the Boring Stuff with Python</i> . William Pollock, 2015.						

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Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Comprehend the holistic view of programming language design and behavior	K2
C02 :	Understand the programming concepts in abstract and paradigm level	K2
C03 :	Structure python programs for solving problems	K3
C04 :	Develop python programs using OOP concept	K5/K6
C05 :	Execute ML project using python tools	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	1	3	1	2	2	1	3	2	1
C02	1	3	1	2	1	1	3	2	1
C03	2	2	2	3	2	3	3	3	2
C04	2	3	0	3	2	3	3	3	1
C05	1	3	3	3	2	3	3	2	2

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI053	Number of Hours/Week	3			
Semester	V	Max. Marks	100			
Course Category	Open Elective	Credits	3			
Course Title	COMPUTER NETWORK			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objective of this course is to prepare the students for:						
<ul style="list-style-type: none"> To understand the concept of Computer network To Category knowledge about networking and inter networking devices 						
UNIT	TOPICS				HOURS	
I	Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.				8	
II	Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues - Error Detection and Correction.				7	
III	Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer - Channel Allocation Problem - Multiple Access Protocols - Bluetooth.				12	
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols.				10	
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography.				8	
<p><u>Text Book :</u></p> <p>1. A. S. Tanenbaum, “Computer Networks”, Prentice-Hall of India 2008, 4th Edition.</p> <p><u>Reference Books:</u></p> <p>1. Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition.</p> <p>2. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.</p>						

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Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	To Learn various principles & concepts of Computer networks.	K1
C02 :	To Analyze different network models.	K4
C03 :	To Evaluate the data flow through TCP/IP & ISO Layers.	K5
C04 :	To Assess key networking protocols and their hierarchical relationship In the conceptual model like TCP/IP and OSI	K5,K6
C05 :	To Identify networking and inter-networking devices	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	0	0	0	3	0	0
C02	3	3	2	0	1	0	2	2	0
C03	3	3	3	2	0	0	3	3	3
C04	3	2	2	0	2	0	2	2	2
C05	3	3	3	1	1	1	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

SEMESTER -VI

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI161	Number of Hours/Wk	3			
Semester	VI	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	PREDICTIVE ANALYSIS			L	T	P
				3	0	0
COURSE OBJECTIVES:						
The main learning objectives of this course are to prepare students to:						
<ul style="list-style-type: none"> • To introduce the fundamentals of predictive analytics and differentiate it from other forms of data analytics, including descriptive and prescriptive analytics. • To equip students with essential statistical and mathematical tools required to understand, build, and evaluate predictive models. • To provide a strong foundation in supervised machine learning techniques used for prediction tasks, including regression, classification, and ensemble methods. • To develop competency in time-series forecasting methods, enabling students to build models that can predict future values based on historical data. • To offer practical exposure through real-world case studies and applications, helping students to apply predictive modeling techniques in diverse domains such as finance, healthcare, and marketing. 						
UNIT	TOPICS				HOURS	
I	Introduction to Predictive Analytics: Introduction to Analytics: Descriptive, Predictive, and Prescriptive Analytics- Predictive Modeling Process: Problem formulation, Data understanding, Data preparation- Types of Predictive Models: Classification, Regression, Time-series- Model evaluation: Overfitting, Underfitting, Bias-Variance tradeoff- Tools and platforms for predictive analytics (e.g., R, Python, SAS, RapidMiner)				9	
II	Statistical Foundations for Prediction: Probability theory and distributions- Descriptive and inferential statistics- Hypothesis testing and confidence intervals- Correlation and causation- Feature selection techniques: Chi-square test, ANOVA, Mutual Information.				9	
III	Machine Learning for Predictive Modeling: Supervised learning: Linear Regression, Logistic Regression, k-NN- Decision Trees and Ensemble Methods: Random Forests, Gradient Boosting- Support Vector Machines (SVM)- Model evaluation metrics: Accuracy, Precision, Recall, F1-score, ROC-AUC- Cross-validation and Hyper-parameter tuning.				9	
IV	Time Series Forecasting: Time Series Components: Trend, Seasonality, Noise-Forecasting methods: Moving Average, Exponential Smoothing, ARIMA-Stationarity and Differencing-ACF and PACF plots-Introduction to advanced models: Prophet, LSTM (optional for advanced students)				9	
V	Applications and Case Studies: Predictive analytics in real-world domains: Finance, Healthcare, Marketing, Supply Chain- Case study: Customer churn prediction /				9	

Credit scoring / Stock price forecasting-Ethics and Privacy in Predictive Modeling-Model deployment: Introduction to APIs and MLOps concepts-Project Work and Presentations.
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Max Kuhn, Kjell Johnson, Applied Predictive Modeling, Publisher: Springer, 1st Edition, 2013, ISBN: 978-1461468486. 2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 2nd Edition, 2021, ISBN: 978-1071614174. 3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2nd Edition, 2019., ISBN: 978-1492032649. <p>Reference Books:</p> <ol style="list-style-type: none"> 1. Francesca Lazzeri, Machine Learning for Time Series Forecasting with Python, Wiley, 1st Edition, July 2020, ISBN: 978-1119682363. 2. Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, Updated Paperback Edition, 2020 (Reprint with updates), ISBN: 978-1098104023.

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Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
CO1 :	Understand the role of predictive analytics in the broader data science ecosystem.	K6
CO2 :	Apply fundamental statistical techniques for data analysis and hypothesis testing.	K3
CO3 :	Build regression and classification models for structured data prediction.	K6
CO4 :	Understand the components of time-series data: trend, seasonality, and noise.	K6
CO5 :	Analyze predictive models through real-world applications (e.g., churn, risk scoring).	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	2	3	2
CO2	3	3	2	3	2	1	3	3	2
CO3	3	3	3	2	3	1	3	3	2
CO4	3	2	2	2	3	1	3	3	2
CO5	2	3	3	2	3	2	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI			
Course Code	25BCAI162	Number of Hours/Wk	3			
Semester	VI	Max. Marks	100			
Course Category	Core Course	Credits	3			
Course Title	COMPILER DESIGN			L	T	P
				3	0	0

COURSE OBJECTIVES:

The main learning objectives of this course are to prepare students to:

- To learn the various phases of compiler parsing techniques.
- To understand intermediate code generation and run-time environment.
- To learn to implement the front-end of the compiler.
- To learn to implement code generator.
- To learn to implement code optimization.

UNIT	TOPICS	HOURS
I	Introduction To Compilers & Lexical Analysis Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA – Language for Specifying Lexical Analyzers – Lex tool.	9
II	Syntax Analysis: Role of Parser – Grammars – Context-free grammars – Writing a grammar Top Down Parsing General Strategies – Recursive Descent Parser Predictive Parser-LL(1) – Parser-Shift Reduce Parser-LR Parser-LR (0)Item Construction of SLR Parsing Table – Introduction to LALR Parser Error Handling and Recovery in Syntax Analyzer-YACC tool – Design of a syntax Analyzer for a Sample Language	9
III	Syntax Directed Translation & Intermediate Code Generation: Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator – Type Systems-Specification of a simple type Checker Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching.	9
IV	Run-Time Environment And Code Generation: Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack, and Heap allocation – Parameter Passing-Symbol Tables – Dynamic Storage Allocation – Issues in the Design of a code generator – Basic Blocks and Flow graphs Design of a simple Code Generator – Optimal Code Generation for Expressions– Dynamic Programming Code Generation.	9
V	Code Optimization: Classification of optimization, Principle sources of optimization, Optimization of basic blocks, Peephole Optimization, Loops in flow	9

graphs, Local optimization, Global optimization, Data flow analysis of flow graph.
<p><u>Text Book:</u></p> <ol style="list-style-type: none"> 1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Second Edition, Pearson Education, 2009. <p><u>Reference Books:</u></p> <ol style="list-style-type: none"> 1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002. 2. Steven S. Muchnick, Advanced Compiler Design and Implementation , Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003. 3. Keith D Cooper and Linda Torczon, Engineering a Compiler , Morgan Kaufmann Publishers Elsevier Science, 2004. 4. V. Raghavan, Principles of Compiler Design , Tata McGraw Hill Education Publishers, 2010. 5. Allen I. Holub, Compiler Design in C , Prentice-Hall Software Series, 1993.

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Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Learn Compiler phases, passes, and language translation mechanisms.	K6
C02 :	Understand the concept of token generation, parsing techniques, symbol table and intermediate code generation.	K3
C03 :	Apply syntax-directed translation to generate intermediate code representations, such as syntax trees and three-address code, and perform type checking.	K6
C04 :	Understand various types of errors and error handling techniques	K6
C05 :	Apply the code optimization algorithms.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	1	2	2	3	2	1
C02	2	3	2	1	3	2	2	3	2
C03	3	2	3	2	2	3	3	2	2
C04	2	3	2	3	2	1	2	1	3
C05	1	1	2	3	1	2	1	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI261	Number of Hours/Wk	2		
Semester	VI	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	PREDICTIVE ANALYSIS LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

- To develop practical knowledge of predictive modeling techniques.
- To implement machine learning algorithms for real-world predictive tasks.
- To gain hands-on experience in data preprocessing, feature engineering, and model evaluation.
To work with real-world datasets using modern tools and programming environments.

List of Experiments

Introduction & EDA

1. Loading datasets and performing basic EDA (using Pandas/Seaborn/Matplotlib).
2. Data preprocessing: handling missing data, encoding, normalization, etc.

Regression Techniques

3. Simple Linear Regression & Multiple Linear Regression.
4. Ridge, Lasso, and ElasticNet regression.
5. Model evaluation: RMSE, MAE, R^2 , cross-validation.

Classification Techniques

6. Logistic Regression and performance metrics (Confusion Matrix, Precision, Recall, F1-score, ROC).
7. Decision Trees and Random Forest Classifier.
8. Support Vector Machines (SVM) and k-Nearest Neighbors (k-NN).

Ensemble and Advanced Methods

9. Bagging and Boosting (AdaBoost, Gradient Boosting, XGBoost).
10. Hyperparameter tuning with GridSearch CV / Randomized Search CV.

Time Series and Forecasting

11. Time series decomposition, ARIMA modeling using statsmodels.
12. Prophet or LSTM-based forecasting (optional for advanced students).

Capstone / Mini Project

13. End-to-end predictive modeling project using real-world datasets (e.g., from Kaggle, UCI, or Govt. datasets).
14. Data cleaning, visualization, model selection, training, testing, and reporting.

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Understand the role of predictive analytics in the broader data science ecosystem.	K6
C02 :	Apply fundamental statistical techniques for data analysis and hypothesis testing.	K3
C03 :	Build regression and classification models for structured data prediction.	K6
C04 :	Understand the components of time-series data: trend, seasonality, and noise.	K6
C05 :	Analyze predictive models through real-world applications (e.g., churn, risk scoring).	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C01	3	2	1	1	2	2	2	3	2
C02	3	3	2	3	2	1	3	3	2
C03	3	3	3	2	3	1	3	3	2
C04	3	2	2	2	3	1	3	3	2
C05	2	3	3	2	3	2	3	3	3

(3 - Strong, 2 -Medium, 1 - Low, 0-No Correlation)

Programme	BCA(AI)	Programme Code	BCAI		
Course Code	25BCAI261	Number of Hours/Wk	2		
Semester	VI	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	COMPILER DESIGN LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

- Master lexical analysis tools – build both manual and Lex-based scanners to identify tokens accurately.
 - Design and implement parsers – convert grammars to YACC specifications, construct ASTs, and resolve syntax errors.
 - Apply semantic analysis – implement symbol tables, type checking, and control/data-flow analyses for semantic correctness.
 - Simulate run-time behavior – experiment with storage-allocation strategies and DAG construction to support code generation.
- Introduce code optimisation techniques – perform basic-block, peephole, and global optimisations to improve compiled output efficiency.

List of Experiments

1. Implementation of Symbol Table
2. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)
3. Implementation of Lexical Analyzer using Lex Tool
4. Generate YACC specification for a few syntactic categories.
 - a) Program to recognize a valid arithmetic expression that uses operator +, -, * and /.
 - b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
 - c) Implementation of Calculator using LEX and YACC
5. Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.
6. Implement type checking
7. Implement control flow analysis and Data flow Analysis
8. Implement any one storage allocation strategies (Heap, Stack)
9. Construction of DAG
15. 10. Implementation of Simple Code Optimization Techniques.

Course Outcomes

On successful completion of this course, the student will be able to

CO's	Outcomes	K -Level's
C01 :	Learn Compiler phases, passes, and language translation mechanisms.	K6
C02 :	Understand the concept of token generation, parsing techniques, symbol table and intermediate code generation.	K3
C03 :	Apply syntax-directed translation to generate intermediate code representations, such as syntax trees and three-address code, and perform type checking.	K6
C04 :	Understand various types of errors and error handling techniques	K6
C05 :	Apply the code optimization algorithms.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	P01	P02	P03	P04	P05	P06	PSO1	PSO2	PSO3
C01	3	2	1	1	2	2	3	2	1
C02	2	3	2	1	3	2	2	3	2
C03	3	2	3	2	2	3	3	2	2
C04	2	3	2	3	2	1	2	1	3
C05	1	1	2	3	1	2	1	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)