||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R)

SJB INSTITUTE OF TECHNOLOGY

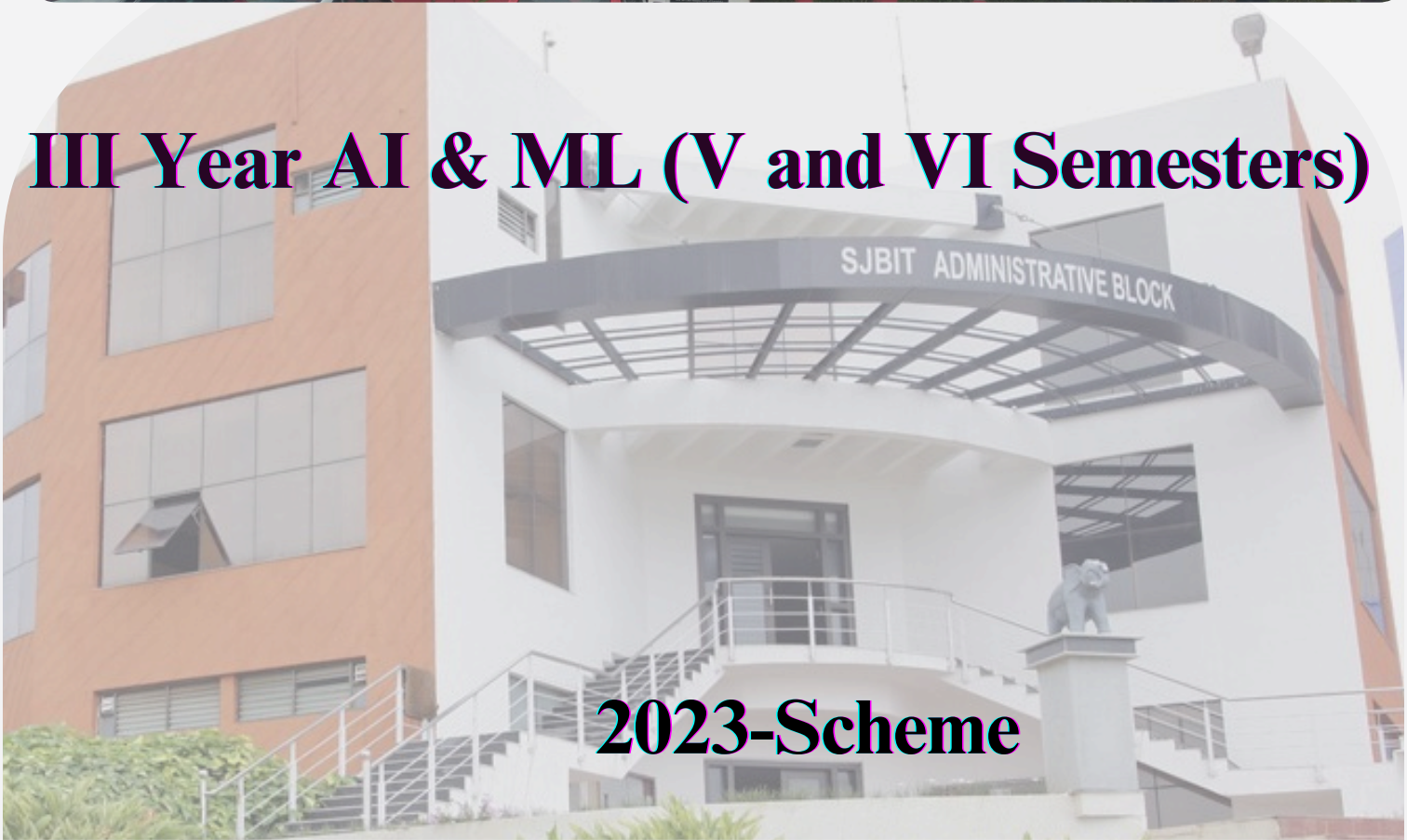
An AUTONOMOUS INSTITUTION UNDER VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Approved by AICTE, 2(f) and 12(B) recognized by UGC, New Delhi
Accredited by NAAC, Accredited by NBA, Certified by ISO 9001 - 2015

Department of Artificial Intelligence and Machine Learning

BE

Autonomous Scheme & Syllabus



III Year AI & ML (V and VI Semesters)

2023-Scheme

SERVICE TO MANKIND IS SERVICE TO GOD

His Divine Soul Bhairavaikya Padmabhushana

Sri Sri Sri Dr. Balagangadharanath MahaSwamiji

Founder President, Sri Adichunchanagiri Shikshana Trust®

Belief in God is not ignorance or illusion. It is a belief that there is an unseen, ineffable Power that transcends all our powers of muscles, mind and lives.

His Holiness Parama Pujya

Sri Sri Sri Dr. Nirmalanandanatha MahaSwamiji

President, Sri Adichunchanagiri Shikshana Trust ®

True richness is the generosity of heart. Cultivate it and work to help the less fortunate ones in life.

Revered Sri Sri Dr. Prakashanatha Swamiji

Managing Director, BGS & SJB Group of Institutions & Hospitals

People and prosperity follow the path which the leaders take. So the elders and leaders should make sure that they give the right lead and take the right path.

Institution Vision:

To become a recognized technical education center with a global perspective.

Institution Mission:

To provide learning opportunities that foster students' ethical values, intelligent development in science technology and social responsibility so that they become sensible and contributing members of society

Department Vision:

To gain global acclaim by fostering excellence in education, research, and innovation, thereby creating leaders who influence society through technology.

Department Mission:

M1: Foster a comprehensive understanding of both the theory and application of Artificial Intelligence and Machine Learning.

M2: Establish a conducive learning environment that nurtures globally competitive skills.

M3: Nurture innovation and ethics, preparing students as responsible societal members.

2023 Scheme – UG

Syllabus for 5th & 6th Semester

The syllabus, scheme and guidelines are provided in detail.
The syllabus, scheme and guidelines are subjected to changes if any needed.
The updates will be done timely.
Regularly access the institution website for the updated information.

The Syllabus book is available on	www.sjbit.edu.in
For any queries, please write to	academicdean@sjbit.edu.in

UPDATES

Release / Revision	Date	Remarks
Release	09/04/2025	First release
Version 2	10/02/2025	Changed CIE and SEE Guidelines

Department of Artificial Intelligence & Machine Learning

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SJB Institute of Technology

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 3rd Year AIML

SCHEME: 2023 **SEM: V** **Revision date: 9th April 2025**

S. #	Course Type	Course type Series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O	CIE Marks	SEE (Dur. & Marks)			
								Lecture	Tutorial	Practical	PBL/ABL / SL/etc.		Dur.	Th.	Lab	Tot.
1	PCC	3	23AIT501	Theory of Computations	AIML	AIML	**3**	3	0	0		50	03	50	-	100
2	IPCC	5	23AII502	Computer Networks	AIML	AIML	**4**	3	0	2	PBL	50	03	50	-	100
3	IPCC	6	23AII503	Machine Learning	AIML	AIML	**4**	3	0	2	ABL	50	03	50	-	100
4	PCCL	3	23AIL504	Data Visualization Lab	AIML	AIML	**1**	0	0	2		50	03	-	50	100
5	PEC	1	23AIP51y	Professional Elective Course - 1	AIML	AIML	**3**	3	0	0		50	03	50	-	100
6	ETC	3	23AIE53y	Emerging Technology Course - 3	AIML	AIML	**3**	3	0	0	@	50	03	50	-	100
7	HSMC	6	23SFHH06/ 23UHVH07	Bioscience or UHV-Universal Human Values	any dept	any dept	**1**	0	2	0	@	50	02	50	-	100
8	AEC	5	23AIAE5y	Ability Enhancement Course - 5	AIML	AIML	**1**	1	0	0		50	02	50	-	100
								(or)								
								0	0	2		50	02	-	50	100
9	NCMC	4	23PASN01	Physical Education - Sports and Athletics	PED	PED	**PP/NP**	-	-	-	2	50	-	-	-	50
			23YOGN02	Yoga	PED	PED										
			23NSSN03	NSS - National Service Scheme	NSS	NSS										
			23NCCN04	NCC - National Cadet Corps	NCC	NCC										
			23IKSN05	Indian Knowledge System	HSS	HSS										
Total							**20**	**16**	**2**	**8**	**2**	**450**		**350**	**100**	**850**

PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; AEC: Ability Enhancement Course; HSMC: Humanities, Social Sciences & Management Course; NCMC: Non Credit Mandatory Course;
{@ - Compulsory one activity during the semester};
{I.E.-Industry Experts}.
PBL: project Based learning; ABL: Activity Based Learning; SL: Self-Learning

ETC (Emerging Technology Course):

For ETC (L:T:P:O) can be plaanned by the depts considering practicality & possibility of conduction, same shall be indicated along with course title in the list, if altered than above. If planned altering the prescription, the same shall be approved at the department BOS & authorities. Atleast one activity is mandatory during the delivery of the course. The guidelines is applicable to all the semesters III to VI semesters (ETC-1 to ETC-4).

Bioscience & UHV-Universal Human Values:

1) Any one of the course will be offered by the departments in each semester of IV & V based on the institutional planning.
2) Both the courses shall be studied and completed by the students registering each in the two semesters. For example, if Bioscience is offered in the IV semester, UHV-Universal Human Values is offered in the V semester.

Ability Enhancement Course-5: 23xxAE5y - 1 Credit course

1) The courses and the syllabus shall be defined by the respective dept. BOS.
2) SEE will be MCQ if offered as theory course. If offered as LAB course, SEE will be practical, with two internal examiners. Handled by Controller of Examinations.

NCMC (Non Credit Mandatory Course) for course type series-4: Refer to guidelines in III SEM.

Professional Elective Course - 1		Emerging Technology Course - 3		Ability Enhancement Course - 5	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
23AIP511	Fundamentals of Digital Image Processing	23AIE531	Android Development with Kotlin	23AIAE51	Julia
23AIP512	Cloud Computing	23AIE532	PyTorch	23AIAE52	Green IT
23AIP513	Introduction to Graph Database	23AIE533	Predictive Analytics	23AIAE53	R-Programming
23AIP514	Information Retrieval	23AIE534	Ethical Hacking	23AIAE54	Technical writing using LaTeX

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 3rd Year AIML

SCHEME: 2023 **SEM: VI** **Aca: 2025-26** **Revision date: 9th April 2025**

S. #	Course Type	Course type Series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O	CIE Marks	SEE (Dur. & Marks)			
								Lecture	Tutorial	Practical	PBL/ABL / SL/etc.		Dur.	Th.	Lab	Tot.
1	PCC	4	23AIT601	Language Translation Techniques	AIML	AIML	3	3	0	0		50	03	50	-	100
2	IPCC	7	23AII602	Natural Language Processing	AIML	AIML	4	3	0	2	PBL	50	03	50	-	100
3	PCCL	4	23AIL603	Language Translation Techniques lab	AIML	AIML	1	0	0	2		50	03	-	50	100
4	PEC	2	23AIP62y	Professional Elective Course - 2	AIML	AIML	3	3	0	0		50	03	50	-	100
5	OEC	1	23AIO61y	Open Elective Course - 1	Any dept.	Any dept.	3	3	0	0		50	03	50	-	100
6	ETC	4	23AIE64y	Emerging Technology Course - 4	AIML	AIML	3	3	0	0	@	50	03	50	-	100
7	AEC	6	23RMAE61	Research Methodology & IPR	AIML	AIML	3	3	0	0	@	50	03	50	-	100
8	PRJ	1	23AIPRJ1	Major Project - Phase I	AIML	AIML	2	0	0	4	@	50	03	-	50	100
9	HSMC	7	23SCRH08	Social Connect & Responsibility	Any dept	Any dept	1	1	0	0	@	50	-	-	-	50
10	NCMC	4	23PASN01	Physical Education - Sports and Athletics	PED	PED	PP/NP	-	-	-	2	50	-	-	-	50
			23YOGN02	Yoga	PED	PED										
			23NSSN03	NSS - National Service Scheme	NSS	NSS										
			23NCCN04	NCC - National Cadet Corps	NCC	NCC										
			23IKSN05	Indian Knowledge System	HSS	HSS										
Total							**23**	**19**	**0**	**8**	**2**	**500**		**300**	**100**	**900**

PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; PEC: Professional Elective Course; OEC: Open Elective Course;
HSMC: Humanities, Social Sciences & Management Course; AEC: Ability Enhancement Course; NCMC: Non Credit Mandatory Course; PRJ: Project work.
{@ - Compulsory one activity during the semester}; {I.E.-Industry Experts}; PBL: project Based learning; ABL: Activity Based Learning; SL: Self-Learning
NOTE: CIE & SEE guidelines for S. #7: AEC-23RMAE61-Research Methodology & IPR will be same as 3 credit courses BSC/ESC/PCC/ETC/PEC/OEC as mentioned in serial no. 1 of CIE & SEE guidelines.

Open Elective Courses (OEC):
1) Open Electives listed here are to offer for other department students.
2) Students shall select open elective courses offered from other departments, separate consolidated list of courses offered from various departments will be published time to time.

ETC (Emerging Technology Course):
For ETC (L:T:P:O) can be plaanned by the depts considering practicality & possibility of conduction, same shall be indicated along with course title in the list, if altered than above. If planned altering the prescription, the same shall be approved at the department BOS & authorities. Atleast one activity is mandatory during the delivery of the course. The guidelines is applicable to all the semesters III to VI semesters (ETC-1 to ETC-4).

NCMC (Non Credit Mandatory Course) for course type series-4: Refer to guidelines in III SEM.

Professional Elective Course - 2 (23AIP62y)		Open Elective Course - 1 (23AIO61y)		Emerging Technology Course - 4 (23AIE64y)	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
23AIP621	Introduction to Vector Database	23AIO611	Introduction to Artificial Intelligence	23AIE641	UI/UX using Flutter
23AIP622	Natural Computing	23AIO612	OOPs with C++	23AIE642	Django Framework and Applications
23AIP623	Human-Centred AI	23AIO613	Introduction to Java Programming	23AIE643	Scalable Data Analytics
23AIP624	Distributed Systems	23AIO614	Introduction to Operating systems	23AIE644	Network Security

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Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	PCC		
Course Title: Theory of Computations					
Course Code:	**23AIT501**			**Credits:**	3
Teaching Hours/Week (L: T: P: O) {O – Other pedagogies, mention @}			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	03

Pre-requisite: Set theory, elementary formal logic, proof construction, and recurrence relations.

I. Course Objectives:

- Understand the fundamental concepts of Automata and the Theory of Computation.
- Explore various classes of formal languages and their interrelationships.
- Study grammars and recognizers for different types of formal languages.
- Apply properties of automata theory to prove or disprove theorems.
- Evaluate the decidability and computational complexity of different problems.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Module-1Introduction to Finite Automata	8 Hrs

Introduction to Finite Automata, Structural Representations, Automata and Complexity. The Central Concepts of Automata Theory. Deterministic Finite Automata, Nondeterministic Finite Automata, An Application: Text Search, Finite Automata with Epsilon-Transitions.

TEXTBOOK: **Sections 1.1, 1.5, 2.2,2.3,2.4,2.5**

RBT Levels: L1, L2, L3

Module-2 Regular Expressions and Languages	8 Hrs
Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be Regular. Closure Properties of Regular Languages, Equivalence and Minimization of Automata, Applications of Regular Expressions **TEXTBOOK: Sections 3.1, 3.2, 3.3, 4.1, 4.2, 4.4**	
RBT Levels: L1, L2, L3	
Module-3 Context Free Grammar and Languages	8 Hrs
Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages, Ambiguity in Grammars and Languages, Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata. **TEXTBOOK**: **Sections 5.1, 5.2, 5.4, 6.1,6.2,6.3.1,6.4**	
RBT Levels: L1, L2, L3	
Module-4 Normal Forms for Context-Free Grammars	8 Hrs
Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages. **TEXTBOOK: Sections 7.1, 7.2, 7.3**	
RBT Levels: L1,L2,L3	
Module-5 Introduction to Turing Machines	8 Hrs
Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Undecidability: A Language That Is Not Recursively Enumerable. **TEXTBOOK: Sections 8.1,8.2**, **8.3,8.4, 9.1, 9.2**	
RBT Levels: L1,L2,L3	

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Design Deterministic Finite Automata (DFAs), Non-deterministic Finite Automata (NFAs), Epsilon-NFAs, and apply conversion techniques between these models.
CO2	Prove the properties of regular languages using regular expressions
CO3	Construct Context-Free Grammars (CFGs) and Pushdown Automata (PDAs) for representing formal languages.
CO4	Design Turing machines to solve computational problems and explain the concepts of decidability and undecidability in computational theory.
CO5	Explain the concepts of decision making in computational theory.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	3	3										1	1	
CO2	3	3	2										1	1	
CO3	3	3	3										1	1	
CO4		3	3	1									1	2	
CO5	3	2		1									1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Introduction to Automata Theory, Languages and Computation	John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman	Second Edition	Pearson.

VII(b): Reference Books:

1	Automata, Computability and complexity	Elain Rich,	1st Edition, 2018.	Pearson Education,
2	Theory of Computer Science	K.L.P Mishra, N Chandrashekaran	3rd Edition, 2012.	PHI,
3	An Introduction to Formal Languages and Automata	Peter Linz	3rd Edition, 1998	Narosa Publishers,
4	Introduction to the Theory of Computation	Michael Sipser	3rd edition, 2013	Cengage learning
5	Introduction to Languages and The Theory of Computation	John C Martin	3rd Edition, 2013.	Tata McGraw –Hill Publishing Company Limited

VII(c): Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105196/
- https://archive.nptel.ac.in/courses/106/106/106106049/
- https://nptelvideos.com/course.php?id=717

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar

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Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	IPCC		
Course Title: Computer Networks					
Course Code:	**23AII502**			**Credits:**	04
Teaching Hours/Week (L: T: P: O)			3:0:2:O	**Total Hours:**	40+10 slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03
Pre-requisite: Fundamentals of Computers and its components					

I. Course Objectives:

- This course enables students to understand the importance of computer networks, provides knowledge of LANs, MANs, and WANs, internet protocols, network metrics, and applications.
- Students will acquire basic knowledge of various internetworking devices, network protocols, and routing concepts.

II. Teaching-Learning Process:

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III COURSE CONTENT

III(a). Theory PART

Module-1 Introduction to Computer Networks	8 Hrs

Introduction to Computer Network, Characteristics of a Computer Networks, Classification of Computer Networks, Computer Network Applications, Advantages of networking, Computer Network Topologies, Transmission media, Wireless Transmission, OSI Reference Model, TCP/IP Model.
Textbook 1: Chapter 1.2 to 1.4, Chapter 2.2 to 2.3

RBT Levels: L1, L2, L3	
Module-2 Data Link layer	**8 Hrs**
The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols. The medium access control sublayer: The channel allocation problem, Multiple access protocols. **Textbook 1: Ch.3.1 to 3.4, Ch.4.1 and 4.2**	
RBT Levels: L1, L2, L3	
Module-3 Network layer	**8 Hrs**
The Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, QoS. **Textbook 1: Ch 5.1 to 5.4**	
RBT Levels: L1, L2, L3	
Module-4 Transport Layer	**8 Hrs**
The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols: UDP and TCP **Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7**	
RBT Levels: L1, L2, L3	
Module-5 Application Layer	**8 Hrs**
Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet. **Textbook 2: Ch 2.1 to 2.4**	
RBT Levels: L1, L2, L3	

III(b). PRACTICAL PART.

Sl. No.	Experiments
	PART-A
1	Study of basic networking commands and IP configuration.
2	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth, and find the number of packets dropped.
3	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
4	Develop a program for error detecting code using CRC-CCITT (16- bits).
5	Develop a program to find the shortest path between vertices using the Bellman-Ford and Path vector routing algorithm.
6	Write an HTTP web client program to download a web page using TCP sockets.
7	Develop a program for a simple RSA algorithm to encrypt and decrypt the data.
8	Develop a program for congestion control using a Leaky bucket algorithm.
	PART-B
	A team of 4 students can develop mini projects by focusing on key network concepts. They can utilize tools and programming languages they are familiar with, such as Python, Java, or C++. To enhance the projects further, they can incorporate advanced features, such as handling multiple concurrent connections, adapting to dynamic network conditions, and integrating real-world networking libraries.

Instructions for conduction of practical part:

- **LAB Activities:** Conduct laboratory exercises, prepare lab reports, observations and analyze results, perform lab tests, and work on design and implementation tasks.
- **Experiential Learning**: Students will be evaluated based on their creativity and practical problem-solving skills. This includes program-specific requirements and video-based seminars, presentations, or demonstrations.

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	**Explain** the basic terminologies used in networking and layered architecture of computer network.
CO2	**Classify** basic protocols of application layer and how they can be used to assist in network design and implementation.
CO3	**Describe** the essential principles of a connectionless and connection-oriented protocols used for reliable data transfer, flow control and congestion control.
CO4	**Design** network architecture, assign IP addressing and utilize routing algorithms to get shortest paths for network-layer packet delivery.
CO5	**Illustrate** the link layer terminologies like error detection-correction, multiple access protocol and link layer addressing used in network.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3												2		1
CO2	3				2								2		1
CO3	3	2			3							3	2	1	1
CO4	3	2	3	2	3							3	2	2	1
CO5	3	2	3	2	3							3	2		1

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.2

Semester End Examination (SEE): Refer Annexure-1 Sl.No.2

VII. Learning Resources

VII(a): Textbooks

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Computer Networks	Andrew S. Tanenbaum	2016	Pearson Education
2	Data Communications and Networking	Behrouz A. Forouzan	5th Edition, 2013	Tata McGraw-Hill

VII(b): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	TCP/IP Protocol Suite	Behrouz Forouzan	3rd ,2016	Tata McGraw-Hill Education
2	Computer Networking- A Top-Down Approach	Kurose and Ross	4th ,2015	Pearson Education
3	Computer Networks – A Systems Approach,	Larry L. Peterson and Bruce S. Davie	4th Edition, 2019.	Elsevier

VII(c): Web links and Video Lectures (e-Resources):

1.https://www.digimat.in/nptel/courses/video/106105183/L01.html 2. http://www.digimat.in/nptel/courses/video/106105081/L25.html 3. https://nptel.ac.in/courses/10610
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Assignments, Quizzes, Seminar and Mini Project

|| Jai Sri Gurudev ||
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Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	IPCC		
Course Title: Machine Learning					
Course Code:	**23AII503**			**Credits:**	04
Teaching Hours/Week (L: T: P: O)			3:0:2:O	**Total Hours:**	40+10 slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Data Structures, Basics of Probability and Statistics

I. Course Objectives:

- The course is designed to analyze and implement various machine learning algorithms and techniques, with a focus on recent advancements.
- It explores both supervised and unsupervised learning paradigms.

II. Teaching-Learning Process:

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III COURSE CONTENT

III(a). Theory PART

Module-1 Introduction	8 Hrs

Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.

Text book1:Chapter-1

RBT Levels: L1, L2, L3

Module-2 **Understanding Data**	**8 Hrs**
Understanding Data – 1: Introduction, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization. **Understanding Data – 2**: Bivariate Data and Multivariate Data, Multivariate Statistics, Essential Mathematics for Multivariate Data, Feature Engineering and Dimensionality Reduction Techniques. **Text book1:Chapter-2 - 2.1-2.8, 2.10**	
RBT Levels: L1, L2, L3	
Module-3 Supervised Learning Algorithms	**10 Hrs**
Similarity-based Learning: Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis**: Introduction to Regression, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression. **Decision Tree Learning**: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms. **Text book1:Chapter-4[4.2-4.5] , Chapter-5[5.1-5.3,5.5-5.7], Chapter-6[6.1,6.3]**	
RBT Levels: L1, L2, L3	
Module-4 Advanced Machine Learning Techniques	**7Hrs**
Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Naïve Bayes Algorithm for Continuous Attributes. **Artificial Neural Networks**: Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN. **Text book1:Chapter-8[8.1-8.4] , Chapter-10[10.1-10.5,10.9-10.11]**	
RBT Levels: L1, L2, L3	
Module-5 Clustering and Reinforcement Learning Algorithms	**7Hrs**
Clustering Algorithms: Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-based Methods, Grid-based Approach. **Reinforcement Learning**: Overview of Reinforcement Learning, Scope of Reinforcement Learning, Reinforcement Learning as Machine Learning, Components of Reinforcement Learning, Markov Decision Process, Q-Learning, SARSA Learning. **Text book1:Chapter-13[13.1-13.6] , Chapter-14[14.1-14.5,14.9-14.10]**	
RBT Levels: L1, L2, L3	

III(b). PRACTICAL PART.

Sl. No.	Experiments
1.	Concept learning: Find S-algorithm.
2.	Develop a Candidate elimination algorithm.
3.	Implement KNN Classification with given dataset
4.	Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset from 4 features to 2.
5.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for the experiment and draw graphs.
6.	Demonstrate the working of XOR gate using ANN and Tanh function.
7.	Develop a program to implement k-means clustering using Wisconsin Breast Cancer data set and visualize the clustering result.
8.	Implement Frequent Pattern growth algorithm with given dataset

Instructions for conduction of practical part:

- **LAB Activities:** Conduct laboratory exercises, prepare lab reports, observations and analyze results, perform lab tests, and work on design and implementation tasks.
- **Experiential Learning**: Students will be evaluated based on their creativity and practical problem-solving skills. This includes program-specific requirements and video-based seminars, presentations, or demonstrations.

IV. COURSE OUTCOMES: At the end of this course, students will be able to:

CO1	**Classify** the concepts of machine learning algorithms with its types
CO2	**Solve** the real-world problems using supervised algorithms
CO3	**Apply** unsupervised learning techniques for solving problems.
CO4	**Choose** appropriate algorithms to generate model for solving real-world problems
CO5	**Summarize** artificial neural network in machine learning.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	2											1		
CO2	3			3	2								1		
CO3	3		3		2								1		
CO4	3		3	2	3								1	1	
CO5	3		3	2	3	2							1	1	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.2

Semester End Examination (SEE): Refer Annexure-1 Sl.No.2

VII. Learning Resources

VII(a): Textbooks

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Machine Learning	S Sridhar, M Vijayalakshmi	2021, First Edition	OXFORD University Press 2021

VII(b): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Machine Learning	Murty, M. N., and V. S. Ananthanarayana	2024	Universities Press
2	Machine Learning	T. M. Mitchell	1997	McGraw Hill

VII(c): Web links and Video Lectures (e-Resources):

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes, Seminar and Mini Project

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Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	**PCCL**		
Course Title: Data Visualization Lab					
Course Code:	23AIL504			**Credits:**	1
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			0:0:2:0	**Total No. of LAB Slots:**	12
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Lab**			**Exam Hours:**	03
Pre-Prerequisite: Programming knowledge of C/C++					

III. Course Objectives:

- Demonstrate the use of IDLE or PyCharm IDE to create Python applications
- Use the Python programming language to develop programs for solving real-world problems.
- Implement Matplotlib for creating various types of plots.
- Demonstrate proficiency in working with Seaborn and Bokeh.
- Work with Plotly for 3D plots, time series analysis, and maps.

IV. Teaching-Learning Process (General Instructions):

- List of problems for which students should develop and execute programs in the laboratory using Python.

III. COURSE CONTENTS

Sl. No.	Laboratory Experiments
	Write a Python Program.
1	a) To find the highest average of two out of three test scores entered by the user. b) To check if a given number is a palindrome and count the occurrences of each digit.
2	a) Define a function F where Fn = Fn-1 + Fn-2. Write a Python program that accepts a value for N (N > 0) and passes it to the function. Display an error message if the input value is invalid. b) To convert binary to decimal and octal to hexadecimal using functions.
3	a) To demonstrate how to draw a bar plot using Matplotlib. b) To demonstrate how to draw a scatter plot using Matplotlib.
4	a) To accept a sentence and count the number of words, digits, uppercase letters, and lowercase letters. b) To find the string similarity between two given strings.
5	a) To demonstrate how to draw a histogram using Matplotlib. b) To draw a pie chart using Matplotlib.
6	To demonstrate the use of customizing Seaborn plots with aesthetic functions.
7	a) To illustrate linear plotting using Matplotlib. b) To illustrate linear plotting with line formatting using Matplotlib.
8	a) To explain how to work with Bokeh line graphs using annotations and legends. b) To plot different types of plots using Bokeh.
9	To create 3D plots using the Plotly library.
10	a) To draw Time Series using Plotly Libraries. b) For creating Maps using Plotly Libraries.

Instructions for conduction of practical part:

- **LAB Activities:** Conduct laboratory exercises, prepare lab reports, observations and analyze results, perform lab tests, and work on design and implementation tasks.
- **Experiential Learning**: Students will be evaluated based on their creativity and practical problem-solving skills. This includes program-specific requirements and video-based seminars, presentations, or demonstrations.

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	**Implement** Basic Python functions and Control structures
CO2	**Develop** Data handling and Processing skills
CO3	**Create** Data Visualizations using Python Libraries
CO4	**Apply** Advanced plotting techniques to Create complex visualizations

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/ PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2		1		2								2	1	1
CO2	2	2			2								1	2	
CO3	2		3		2								2	2	1
CO4	2	2	2		2								1	2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.2 Section-4

Semester End Examination (SEE): Refer Annexure-1Sl.No.2 Section-4

VII. Learning Resources

VI(a): Textbooks: (Insert or delete rows as per requirement)

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Automate the Boring Stuff with Python	Al Sweigart	1st Edition, 2015.	No Starch Press,
2	Python Programming Using Problem Solving Approach	Reema Thareja	1st Edition, 2017.	Oxford University Press.
3	Think Python: How to Think Like a Computer Scientist	Allen B. Downey	2nd Edition, 2015	Green Tea Press

VI(b): Reference Books: (Insert or delete rows as per requirement)

1	Python Data Science Handbook.	Jake VanderPlas	1st Edition,	O'REILLY

VI(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=_uQrJ0TkZlc

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

For the above experiments, the following pedagogical approaches can be considered: Problem-based learning, Active learning, MOOCs, and Chalk & Talk.

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Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	PEC		
Course Title: Fundamentals of Digital Image Processing					
Course Code:	**23AIP511**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03
Pre-requisite: Mathematics, Programming skills, Signal Processing.					

I. Course Objectives:

- This course provides an in-depth exploration of image processing techniques and algorithms.
- It covers topics ranging from image acquisition and representation to advanced image analysis and computer vision.
- The course emphasizes both theoretical foundations and practical implementation, enabling students to develop the necessary skills for designing and implementing image processing systems.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

 Chalk & Talk Stud. Assignment Web Resources LCD/Smart Boards Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Fundamentals of Image Processing and Image Transforms	8 Hrs

Introduction, Image sampling, Quantization, Resolution, Image le formats, Elements of image processing system, Applications of Digital image processing. Introduction, Need for transform, image transforms, Fourier transform, 2D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform.

Textbook 1

RBT Levels: L1, L2, L3

Module-2 Image Enhancement	8 Hrs

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, smoothing spatialfilters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Textbook 1

RBT Levels: L1, L2,L3

Module-3 Image Restoration	8 Hrs

Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind deconvolution.

Textbook 1

RBT Levels: L1, L2, L3

Module-4 Image Segmentation	8 Hrs

Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour.

Textbook 1

RBT Levels: L1, L2, L3

Module-5 Image Compression	8 Hrs

Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

Textbook 2

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Explain the fundamentals of image processing and the mathematical transforms involved.
CO2	Articulate the filters for image enhancement techniques.
CO3	Apply Linear & Non-linear models using image restoration procedures.
CO4	Describe the image segmentation procedures for Clustering & Edge detection
CO5	Implement the techniques for image compression

V.CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2	2	1									1	2	2	1
CO2	2	1			1								2	1	
CO3	1	2											1	1	
CO4	2		1	2	1							1	2	2	1
CO5	1		1	2									1	2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Digital Image Processing	Gonzaleze and Woods	3rd Edition, 2007	Pearson
2	Digital Image processing	S.Jayaraman, S.Esakkirajan and T.VeeraKumar	1st Edition, 2017	TataMcGraw Hill publishers

VII(b): Reference Books:

1	Digital Image Processing and Analysis-Human and Computer Vision Application with CVIP Tools	ScotteUmbaugh	2nd Edition, 2011	CRC Press

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ArKe6zMkXnk&t=27s

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	PEC		
Course Title: Cloud Computing					
Course Code:	**23AIP512**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Mathematics, Knowledge on Computers and Softwares

I. Course Objectives:

- Introduce the rationale behind the cloud computing revolution and the business drivers
- Understand various models, types and challenges of cloud computing
- Understand the design of cloud native applications, the necessary tools and the design tradeoffs.
- Realize the importance of Cloud Virtualization, Abstraction`s, Enabling Technologies and cloud security

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

 Chalk & Talk Stud. Assignment Web Resources LCD/Smart Boards Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Distributed System Models and Enabling Technologies	8Hrs

Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency.

Textbook1:Chapter1:1.1to1.5

RBT Levels: L1, L2, L3

Module-2 Virtual Machines and Virtualization of Clusters and Data Centers	8Hrs

Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

Textbook1:Chapter3: 3.1 to 3.5

RBT Levels: L1, L2, L3

Module-3 Cloud Platform Architecture over Virtualized Data Centers	8 Hrs

Cloud Computing and Service Models, Data Center Design and Inter connection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management.

Textbook1: Chapter 4: 4.1 to 4.5

RBT Levels: L1, L2, L3

Module-4 Cloud Security	8 Hrs

Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud Security.

Textbook2: Chapter 11:11.1 to 11.3, 11.5 to 11.8, 11.10 to 11.14

RBT Levels: L1, L2, L3

Module-5 Cloud Programming and Software Environments	8 Hrs

Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments.

Textbook1: Chapter 6: 6.1 to 6.5

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Describe various cloud computing platforms and service providers.
CO2	Illustrate the significance of various types of virtualizations.
CO3	Identify the architecture, delivery models and industrial platforms for cloud computing-based applications.
CO4	Analyze the role of security aspects in cloud computing.
CO5	Demonstrate cloud applications in various fields using suitable cloud platforms.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	1	1									1	2		
CO2	2	1		1			1						2	1	
CO3	2	1		2								1	1		2
CO4	2		1									1	1		
CO5	2		1				1					1	2		1

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Distributed and Cloud Computing	Kai Hwang, Geoffrey C Fox, and Jack J Dongarra	1st Edition 2012	Elsevier
2	Cloud Computing Theory and Practice	Dan C. Marinescu	2nd Edition 2018	Elsevier

VII(b): Reference Books:

1	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi	1st Edition 2017	McGraw Hill Education

VII(c): Web links and Video Lectures (e-Resources):

- https://freevideolectures.com/course/4639/nptel-cloud-computing/1.
- https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
- https://www.youtube.com/watch?v=EN4fEbcFZ_E
- https://www.youtube.com/watch?v=RWgW-CgdIk0
- https://www.geeksforgeeks.org/virtualization-cloud-computing-types

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	PEC		
Course Title: Introduction to Graph Database					
Course Code:	**23AIP513**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite:A basic understanding of databases and data modeling concepts is recommended. Familiarity with SQL and relational database systems will be beneficial, but not mandatory.

I. Course Objectives:

- This course introduces graph databases, focusing on their advantages over traditional databases.
- Students will learn to model data using the Labeled Property Graph model, query with Cypher, and design graph database applications.
- The course also covers real-world use cases, graph database internals, and the application of graph theory for predictive analysis.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Introduction	8Hrs

Introduction:What Is a Graph?A High-Level View of the Graph Space, Graph Databases, Graph Compute Engines, The Power of Graph Databases, Performance, Flexibility, Agility,
Options for Storing Connected Data: Relational Databases Lack Relationships, NOSQL Databases Also Lack Relationships, Graph Databases Embrace Relationships

RBT Levels: L1, L2,L3

Module-2 Data Modeling with Graphs	8Hrs

Models and Goals: The Labeled Property Graph Model, Querying Graphs: An Introduction to Cypher, Cypher Philosophy, MATCH, RETURN, Other Cypher Clauses, **A Comparison of Relational and Graph Modeling**: Relational Modeling in a Systems Management Domain, Graph Modeling in a Systems Management Domain, Testing the Model, Cross-Domain Models, Creating the Shakespeare Graph, Beginning a Query, Declaring Information Patterns to Find, Constraining Matches, Processing Results, Query Chaining, Common Modeling Pitfalls, Email Provenance Problem Domain, A Sensible First Iteration, Second Time's the Charm, Evolving the Domain, Identifying Nodes and Relationships, Avoiding Anti-Patterns

RBT Levels: L1, L2, L3

Module-3 Building a Graph Database Application	8 Hrs

Data Modeling: Describe the Model in Terms of the Application's Needs, Nodes for Things, Relationships for Structure, Fine-Grained versus Generic Relationships, Model Facts as Nodes, Represent Complex Value Types as Nodes, Time, Iterative and Incremental Development, **Application Architecture:** Embedded versus Server, Clustering, Load Balancing, **Testing:** Test-Driven Data Model Development, Performance Testing, Capacity Planning: Optimization Criteria, Performance, Redundancy, Load, Importing and Bulk Loading Data: Initial Import, Batch Import

RBT Levels: L1, L2, L3

Module-4 Graphs in the Real World	8 Hrs

Why Organizations Choose Graph Databases, Common Use Cases, Social, Recommendations, Geo, Master Data Management, Network and Data Center Management, Authorization and Access Control (Communications),Real-World Examples, Social Recommendations (Professional Social Network),Authorization and Access Control, Geospatial and Logistics, Global Post data model

RBT Levels: L1, L2, L3

Module-5 Graph Database Internals & Predictive Analysis	8 Hrs

Graph Database Internals: Native Graph Processing, Native Graph Storage, Programmatic APIs-Kernel API, Core API, Traversal Framework, Nonfunctional Characteristics, Transactions, Recoverability, Availability, Scale
Predictive Analysis with Graph Theory: Depth- and Breadth-First Search, Pathfinding with Dijkstra's Algorithm, The A* Algorithm, Graph Theory and Predictive Modeling: Triadic Closures, Structural Balance, Local Bridges

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	**Explain** the fundamentals and advantages of graph databases over relational and NoSQL databases.
CO2	**Apply** the Labeled Property Graph model and cypher to design and optimize graph data models.
CO3	**Design** and implement graph database applications focusing on performance, testing, and scalability
CO4	**Apply** graph databases in real-world use cases like social networks, recommendations, and network management
CO5	**Explore** graph database internals and utilize graph theory for predictive analysis and problem-solving.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3												2		
CO2	2		3	1									2		
CO3	1	2	3											1	
CO4	2	1		1									2		2
CO5	2	2		1									2	2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Graph Databases	Ian Robinson, Jim Webber & Emil Eifrem	2nd Edition,2015	O'Reilly Media

VII(b): Reference Books:

1	Building Knowledge Graphs: A Practitioner's Guide	Jesús Barrasa & Jim Webber	1st Edition 2023	O'Reilly
2	Graph Data Modeling for NoSQL and SQL	Thomas Frisendal	1st Edition 2016	Technics Publications

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=7s6cY_wcehM
- https://www.youtube.com/watch?v=cc0zK8ROnR8
- https://www.youtube.com/watch?v=l41FYUbm2Cw
- https://www.linkedin.com/learning/graph-databases-2
- https://neo4j.com/
- https://www.aclweb.org/anthology/2020.lrec-1.132/
- https://aws.amazon.com/neptune/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	PEC		
Course Title: Information Retrieval					
Course Code:	**23AIP514**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03
Pre-requisite: Mathematics, programming, NLP, Databases.					

I. Course Objectives:

- An information retrieval system is crucial for efficiently accessing relevant data from large datasets.
- Understanding various retrieval models, evaluation factors like precision and recall, and processing techniques such as text, query, and indexing is essential.
- Additionally, user interfaces are important for visualizing search results, improving the user experience, and supporting effective web-based searches.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Introduction	8 Hrs

Introduction: Information retrieval, IR problem, IR System, The web. User interfaces for search: Introduction, how people search, Search interfaces today, Visualization on search interfaces, Design and evaluation of search interfaces.

Textbook: Chapter 1: 1.1 to 1.4, Chapter 2: 2.1 to 2.5

RBT Levels: L1, L2,L3

Module-2 Modeling	8 Hrs

Modeling: IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, other models.

Textbook: Chapter 3: 3.1 to 3.6

RBT Levels: L1, L2,L3

Module-3 Retrieval Evaluation	8 Hrs

Retrieval Evaluation: Retrieval metrics, Reference Collections, User-based evaluation Relevance **feedback and Query expansion**: A framework for feedback methods, Explicit relevance feedback, Explicit feedback through clicks, Implicit feedback through local analysis, Implicit feedback through global analysis

Documents - Languages and Properties: Metadata, Document formats, Text properties, Document preprocessing, Organizing documents, Text compression

Textbook: Chapter 4: 4.3 to 4.5, Chapter 5: 5.2 to 5.6, Chapter 6: 6.2 to 6.3, 6.5 to 6.8

RBT Levels: L1, L2, L3

Module-4 Indexing and searching	8 Hrs

Indexing and Searching: Inverted indexes, Signature files, Suffix trees and suffix arrays, Sequential searching, multi-dimensional indexing.

Textbook: Chapter 9: 9.2 to 9.6

RBT Levels: L1, L2, L3

Module-5 Web retrieval	8 Hrs

Web retrieval: The web, Search engine architectures, Search engine ranking, Managing web data, Search engine user interaction.

Structured Text Retrieval: Structuring Power, Early text retrieval models, XML retrieval, XML retrieval evaluation.

Textbook: Chapter 11: 11.2 to 11.7, Chapter 13: 13.2 to 13.5

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	**Identify** the models and tools for building an Information Retrieval system.
CO2	**Apply** query-based operations for information retrieval.
CO3	**Use text-based** operations for retrieving information from documents.
CO4	**Apply** indexing and searching techniques for information retrieval.
CO5	**Design** a user interface for searching and retrieving information from the web/documents.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2		2		2								2		
CO2	3	2		1									2	2	
CO3	2	1			1								1		
CO4	2		2	1									1	2	
CO5	1	2	2										2		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Modern Information Retrieval	Ricardo Baeza Yates and Berthier Ribeiro Neto	2nd Edition, 2011	Pearson

VII(b): Reference Books:

1	Information Retrieval: Implementing and Evaluating Search Engines	Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack,	2010	The MIT Press
2	Information Storage and Retrieval Systems: Theory and Implementation,	Kowalski, Gerald, Mark T Maybury,	2nd Edition, 2002	Springer
3	Modern Information	Retrieval, Ricardo Baeza-Yates	2007	Pearson Education

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=cv7ztWiIaAM
- https://www.youtube.com/watch?v=ecRMy60oBrA
- https://www.youtube.com/watch?v=dXHxPvAIwcI
- https://www.youtube.com/playlist?list=PLpwnR8mPhhf8m7L_b9cSRLdjPW2soerAd
- https://www.youtube.com/watch?v=m0oiAOgSQFw
- https://www.youtube.com/watch?v=yluvahNq3wk

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)
Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	ETC		
Course Title: Android Development with Kotlin					
Course Code:	**23AIE531**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03
Pre-requisite:A basic understanding of programming concepts and familiarity with object-oriented programming principles is recommended.					

I. Course Objectives:

- The objective of this course is to teach students Android development using Kotlin, covering the fundamentals of Kotlin programming and key Android components.
- Students will learn to build interactive apps, manage data, use APIs, and implement navigation.
- The course will also introduce advanced topics like Android Jetpack, RecyclerView, and app deployment, preparing students to create and publish fully functional Android applications.

II. Teaching-Learning Process (General Instructions)

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Introduction to Kotlin and Android Development	8 Hrs

Introduction to Kotlin: What is Kotlin and why do you use it for Android development? Key features of Kotlin: Concise, expressive, null safety, etc, Setting up the Development Environment, Installing Android Studio and setting up a Kotlin project , Exploring the Android Studio IDE and its features , Kotlin Basics, Variables, Data Types, and Basic Syntax. Control Flow: if, when, loops, Understanding Kotlin's Role in Android Development, Why Kotlin is favored for Android development, Interoperability with Java in Android apps.

TextBook-1: Chapter 1

RBT Levels: L1, L2, L3

Module-2 User Interface (UI) Design and Views	8 Hrs

Understanding Android UI Components, Linear Layout, Relative Layout, Constraint Layout, Working with TextViews, Buttons, EditTexts, Introduction to Material Design, Implementing Input Forms and Buttons, Event Handling and Click Listeners, Managing Layouts for Different Screen Sizes and Orientations

TextBook-2: Chapter 5-7

RBT Levels: L1, L2, L3

Module-3 Activities, Intents, and Data Passing	8 Hrs

Introduction to Activities and Activity Lifecycle, Navigating Between Activities using Intents, Passing Data Between Activities (Bundling and Intent Extras), Implicit vs. Explicit Intents, AndroidManifest.xml and Activity Registration, Working with Parcelable and Serializable Data

TextBook-2: Chapter 8-10

RBT Levels: L1, L2, L3

Module-4 Working with Data and APIs	8 Hrs

Introduction to Recycler View and Adapters, Storing Data Locally using Shared Preferences, SQLite Database in Android, Networking in Android: Using Retrofit and APIs, Parsing JSON Data, Making API Calls in Kotlin, Displaying Data from APIs on the UI (AsyncTask/Coroutines)

TextBook-2: Chapter 11-14

RBT Levels: L1, L2, L3

Module-5 Advanced Topics and Publishing the App	8 Hrs

Introduction to Services (Background Tasks), Working with Broadcast Receivers and Permissions
Using Firebase for Authentication and Realtime Database, Introduction to Android Jetpack Components- ViewModel, LiveData, Navigation Component, Debugging and Testing Android Apps, Preparing and Publishing an Android App to Google Play Store

TextBook-2: Chapter 15-18

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Develop a strong foundation in Kotlin programming for Android app development.
CO2	Design and implement interactive and responsive user interfaces using Android Studio.
CO3	Work with Android components such as Activities, Intents, and Recycler View to build dynamic applications.
CO4	Handle data storage, APIs, and asynchronous operations effectively in Android apps.
CO5	Apply best practices in testing, debugging, and deploying Android applications to the Google Play Store.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3				2								2		2
CO2	2		3	2	3								2		1
CO3	2	2		1									1		
CO4	2												2		
CO5	1		2		1								1		2

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Android Development with Kotlin	Marcin Moskala Igor Wojda	2017	Packt Publishing
2	Android Programming with Kotlin for Beginners	John Horton	2nd Edition, 2020	Packt Publishing

VII(b): Reference Books:

1	Head First Android Development	Dawn Griffiths and David Griffiths	2nd Edition, 2015	O'Reilly Media

VII(c): Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106/105/106105191/ https://nptel.ac.in/courses/106/105/106105225/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	ETC		
Course Title: PyTorch					
Course Code:	**23AIE532**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic knowledge of Python programming, mathematics (linear algebra, calculus, probability), and introductory machine learning concepts.

I. Course Objectives:

- The objective of this course is to provide students with a comprehensive understanding of deep learning concepts and practical experience in building deep learning models using PyTorch.
- Students will learn the fundamentals of tensor operations, image classification, and convolutional neural networks (CNNs), as well as advanced techniques such as transfer learning, data augmentation, and text classification using recurrent neural networks (RNNs).
- By the end of the course, students will be equipped with the skills to implement and optimize deep learning models for real-world applications across various domains

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.
9.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Getting Started with PyTorch	8 Hrs

Introduction to Deep Learning Hardware: CPU, GPU, RAM, and Storage ,Setting Up Deep Learning in the Cloud with Google Collaboratory, Choosing the Right Cloud Provider for Your Projects, Installing and Using PyTorch from Scratch, The Power of Anaconda and CUDA in Deep Learning, PyTorch Basics: What Are Tensors and How Do They Work?, Tensor Operations and Broadcasting in PyTorch, Using Jupyter Notebook for Deep Learning with PyTorch

Textbook 1: Chapter1

RBT Levels: L1, L2, L3

Module-2 Image Classification with PyTorch	8 Hrs

Introduction to Image Classification and Common Challenges, Preparing Data: Building Training, Validation, and Test Datasets, Understanding PyTorch Data Loaders and Dataset Management, Introduction to Neural Networks and Activation Functions, constructing a Neural Network for Image Classification, Defining Loss Functions and Optimizing Your Model, Leveraging the Power of GPU for Faster Training, Saving, Making Predictions, and Final Model Evaluation

Textbook 1: Chapter 2

RBT Levels: L1, L2, L3

Module-3 Convolutional Neural Networks (CNNs)	8 Hrs

Introduction to Convolutional Neural Networks and Basic Operations, Understanding Convolutions, Pooling, and Dropout, Exploring the History and Success of CNN Architectures (AlexNet, VGG, etc.), Using Pretrained CNN Models in PyTorch, Understanding Batch Normalization and Its Benefits, How to Choose the Best CNN Architecture for Your Problem, Exploring PyTorch Hub: A One-Stop Repository for Models, Fine-Tuning Pretrained Models for Custom Use Cases

Textbook 1: Chapter 3

RBT Levels: L1, L2, L3

Module-4 Transfer Learning and Advanced Techniques	8 Hrs

Introduction to Transfer Learning with Pretrained Models, How to Effectively Use ResNet for Transfer Learning, Finding the Optimal Learning Rate with Learning Rate Schedulers, Applying Differential Learning Rates to Different Layers, Data Augmentation Techniques to Improve Model Robustness, Customizing Transformations with Torchvision, Building and Training Ensemble Models for Better Accuracy, Best Practices for Scaling and Refining Deep Learning Models.

Textbook 1: Chapter 4

RBT Levels: L1, L2, L3

Module-5:Text Classification with PyTorch	8 Hrs

Introduction to Recurrent Neural Networks (RNNs) for Text, Advanced RNN Architectures: LSTM, GRU, and BiLSTM, Understanding Word Embeddings and Their Importance in Text Classification, Usingtorchtext for Text Data Processing ,Preparing Data for Text Classification: Tweets as a Dataset, Creating a Custom Text Classification Model with PyTorch , Enhancing Model Performance with Data Augmentation Techniques, Transfer Learning in Text Classification: Fine-tuning Pretrained Models

Textbook 2: Chapter 5

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Identify and implement the fundamentals of PyTorch and Deep learning
CO2	Develop and train image classification models using PyTorch
CO3	Master Convolutional Neural Networks (CNNs) and their applications
CO4	Leverage advanced deep learning techniques like transfer learning and data augmentation
CO5	Build and implement text classification models using PyTorch and RNN architectures

V. CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2			2	2								3		
CO2	1	2	1	2									1		2
CO3	2	2	2		2								2	2	
CO4	2	1	2	2									2		2
CO5	2	1	2	2									1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Programming PyTorch for Deep Learning	Ian Pointer	1st Edition September 2019	O'Reilly
2	Deep Learning with PyTorch	Eli Stevens, Luca Antiga, Thomas Viehmann	1st Edition 2020	O'Reilly

VII(b): Reference Books:

1	Hands-On Machine Learning with PyTorch and TensorFlow	Maxim Lapan	1st Edition 2019	Packt Publishing
2	Deep Reinforcement Learning with Python	Sudharsan Ravichandran	1st Edition 2018	Packt Publishing

VII(c): Web links and Video Lectures (e-Resources):

- https://pytorch.org/docs/stable/
- https://pytorch.org/tutorials/
- https://www.coursera.org/specializations/deep-learning
- https://www.manning.com/books/deep-learning-with-python
- https://course.fast.ai/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	ETC		
Course Title: Predictive Analytics					
Course Code:	**23AIE533**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic knowledge of statistics and data analysis techniques

I. Course Objectives:

- Comprehend the fundamental principles of business analytics.
- Explore various techniques for predictive modeling.
- Analyze the data transformation of different predictors.
- Examine how predictive analytics can be used in decision-making.
- Apply predictive models to generate predictions for new data.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Introduction to Predictive Analytics	8 Hrs

Introduction to Predictive Analytics – Business analytics: types, applications, Analytical Techniques, Tools Predictive Modelling: Propensity Models, Cluster Models, Applications.
Textbook 1: Chapter 1, 2.

RBT Levels: L1, L2, L3

Module-2 Modelling Techniques	8 Hrs
Modelling Techniques: Statistical Modelling, Machine Learning, Empirical Bayes Method,Point Estimation. **Textbook 1: Chapter 3,4**	
RBT Levels: L1, L2, L3	
Module-3 Data Pre-processing	8 Hrs
Data Pre-processing: Data Transformations for Individual Predictors, Data Transformation for Multiple Predictors, Dealing with Missing Values, Removing Predictors, Adding Predictors, Binning Predictors. Over-Fitting and Model Tuning. **Textbook 2: Chapter 3, 4**	
RBT Levels: L1, L2, L3	
Module-4 Regression Models	8 Hrs
Regression Models: Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models Case Study: Compressive Strength of Concrete Mixtures. **Textbook 2: Chapter 5,6,7,8**	
RBT Levels: L1, L2, L3	
Module-5 Classification Models	8 Hrs
Classification Models: Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule-Based Models – Model Evaluation Techniques. **Textbook 2: Chapter 11,12,13,14**	
RBT Levels: L1, L2, L3	

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Explore the importance of predictive analytics and gain the ability to prepare and process data for modeling.
CO2	Apply statistical techniques for predictive modeling.
CO3	Comprehend the transformation of data into predictors.
CO4	Apply regression and classification models for decision-making and evaluate their performance.
CO5	Apply time series forecasting models in a variety of business contexts.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1	2		2									2		
CO2	2		1										2	2	
CO3	1	2		2											
CO4	3	2	1	1									2	2	
CO5	1		2										1	1	2

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Predictive Analytics using R	Jeffrey S. Strickland	1st Edition, 2014	Lulu .Inc
2	Applied Predictive Modeling	Max Kuhn and Kjell Johnson	1st Edition, 2013	Springer

VII(b): Reference Books:				
1	Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst	Dean Abbott	1st Edition, 2014.	Wiley
VII(c): Web links and Video Lectures (e-Resources):				
• https://www.coursera.org/lecture/fundamentals-of-data-analysis/introduction-to-predictiveanalytics-u4H61				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Assignments, Quizzes and Seminar.				

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	ETC		
Course Title: Ethical Hacking					
Course Code:	**23AIE534**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic understanding of networking, operating systems, web technologies, programming, and cybersecurity concepts

I. Course Objectives:

- The course aims to equip students with the ability to describe web applications and identify their vulnerabilities.
- It will also focus on recognizing and explaining vulnerabilities related to authentication, access control, session management, and data sources.
- Additionally, the course will cover how attacks exploit weaknesses in these areas, providing a comprehensive understanding of web application security.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1 Web Application (In)security — 8 Hrs

Web Application (In)security: The Evolution of Web Applications, Common Web Application Functions, Benefits of Web Applications, Web Application Security, "This Site Is Secure", The Core Security Problem: Users Can Submit; Arbitrary Input, Key Problem Factors, The New Security Perimeter, The Future of Web Application Security. **Textbook 1: Ch 1, 2**

RBT Levels: L1, L2, L3

Module-2 Core Defense Mechanisms — 8 Hrs

Core Defense Mechanisms: Handling User Access,Authentication,Session Management, Access Control, Handling User Input, Varieties of Input, Approaches to Input Handling, Boundary Validation, Multistep Validation and Canonicalization, Handling Attackers, Handling Errors, Maintaining Audit Logs, Alerting Administrators, Reacting to Attacks

RBT Levels: L1, L2,L3

Module-3 Attacking Authentication — 8 Hrs

Attacking Authentication: Authentication Technologies, Design Flaws in Authentication Mechanisms, Bad Passwords, Brute-Forcible Login, Verbose Failure Messages, Vulnerable Transmission of Credentials, Password Change Functionality, Forgotten Password Functionality, "Remember Me" Functionality, User Impersonation Functionality, Incomplete Validation of Credentials, Nonunique Usernames, Predictable Usernames, Predictable Initial Passwords, Insecure Distribution of Credentials, Implementation Flaws in Authentication, Fail-Open Login Mechanisms, Defects in Multistage Login Mechanisms, Insecure Storage of Credentials, Securing Authentication, Use Strong Credentials, Handle Credentials Secretively, Validate Credentials Properly, Prevent Information Leakage, Prevent Brute-Force Attacks, Prevent Misuse of the Password Change Function, Prevent Misuse of the Account Recovery Function, Log, Monitor, andNotify
Textbook 1: Ch 6

RBT Levels: L1, L2, L3

Module-4 Attacking Session Management — 8 Hrs

Attacking Session Management: The Need for State, Alternatives to Sessions, Weaknesses in Token Generation, Meaningful Tokens, Predictable Tokens, Encrypted Tokens, Weaknesses in Session Token Handling, Disclosure of Tokens on the Network, Disclosure of Tokens in Logs, Vulnerable Mapping of Tokens to Sessions, Vulnerable Session Termination, Client Exposure to Token Hijacking, Liberal Cookie Scope, Securing Session Management, Generate Strong Tokens, Protect Tokens Throughout Their Life Cycle, Log, Monitor, and Alert
Textbook 1: Ch 7

RBT Levels: L1, L2, L3

Module-5 Attacking Access Controls — 8 Hrs

Attacking Access Controls: Common Vulnerabilities, Completely Unprotected Functionality, Identifier Based Functions, Multistage Functions, Static Files, Platform Misconfiguration, Insecure Access Control Methods, Attacking Access Controls, Testing with Different User Accounts, Testing Multistage Processes, Testing with Limited Access, Testing Direct Access to Methods, Testing Controls Over Static Resources, Testing Restrictions on HTTP Methods, Securing Access Controls, A Multilayered Privilege Model,
Textbook 1: Ch 8, Ch 9

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Explain the security challenges in web applications and discuss the core defense mechanisms.
CO2	Identify flaws in authentication and explain methods for testing and attacking authentication.
CO3	Describe weaknesses in tokens and methods for attacking session management.
CO4	Identify vulnerabilities in access control and discuss methods for exploiting them.
CO5	Illustrate injection methods for attacking data stores.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1	1											2		
CO2	1	2		2											
CO3	1												1		
CO4	2	1		2									2		
CO5	1												1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	The web application hacker's handbook: finding and exploiting security flaws	Dafydd Stuttard, Marcus Pinto	2011	Wiley

VII(b): Reference Books:

1	Hacking Exposed 7: Network Security Secrets & Solutions	Stuart McClure, Joel Scambray and Goerge Kurtz,	2010	Tata Mc Graw Hill Publishers,
2	Microsoft Windows Security Resource Kit,	Bensmith, and Brian Komer,	2010	Prentice Hall of India

VII(c): Web links and Video Lectures (e-Resources):

1. https://owasp.org/
2. https://www.youtube.com/c/TheCyberMentor

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	AEC		
Course Title:	**JULIA**				
Course Code:	**23AIAE51**			**Credits:**	1
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			0:0:2:0	**Total No. of Lab Slots:**	12
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Lab			**Exam Hours:**	03

Pre-requisite: Knowledge on Programming language C, Java

I. Course Objectives:

- To introduce the basics of Julia programming language
- To illustrate the data structures of Julia programming language
- To make use of built-in functions and packages

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Sl. No.	Experiments
1	a. Develop a Julia program to simulate a calculator (for integer and real numbers). b. Develop a Julia program to add, subtract, multiply and divide complex numbers. c. Develop a Julia program to evaluate expressions having mixed data types (integer, real, floating-point number and complex). [Refer Book 2: Chapter 3, 4]

2	a. Develop a Julia program for the following problem: A computer repair shop charges $100 per hour for labour plus the cost of any parts used in the repair. However, the minimum charge for any job is $150. Prompt for the number of hours worked and the cost of parts (which could be $0) and print the charge for the job. b. Develop a Julia program to calculate a person's regular pay, overtime pay and gross pay based on the following: If hours worked is less than or equal to 40, regular pay is calculated by multiplying hours worked by rate of pay, and overtime pay is 0. If hours worked is greater than 40, regular pay is calculated by multiplying 40 by the rate of pay, and overtime pay is calculated by multiplying the hours in excess of 40 by the rate of pay by 1.5. Gross pay is calculated by adding regular pay and overtime pay. [Refer Book 1: Chapter 3]
3	a. An amount of money P (for principal) is put into an account which earns interest at r% per annum. So, at the end of one year, the amount becomes P + P×r/100. This becomes the principal for the next year. Develop a Julia program to print the amount at the end of each year for the next 10 years. However, if the amount ever exceeds 2P, stop any further printing. Your program should prompt for the values of P and r. b. Develop a Julia program which reads numbers from a file (input.txt) and finds the largest number, smallest number, count, sum and average of numbers. [Refer Book 1: Chapter 4]
4	a. Develop a Julia program and two separate functions to calculate GCD and LCM. b. Develop a Julia program and a recursive function to calculate factorial of a number. c. Develop a Julia program and a recursive function to generate Fibonacci series. [Refer Book 1: Chapter 5]
5	a. Develop a Julia program which reads a string (word) and prints whether the word is palindrome. b. Develop a Julia program which reads and prints the words present in a file (input.txt) having Random Data in which words are dispersed randomly (Assumption: a word is a contiguous sequence of letters. A word is delimited by any non-letter character or end-of-line). [Refer Book 1: Chapter 6]
6	a. Develop a Julia program to determine and print the frequency with which each letter of the alphabet is used in given line of text. b. A survey of 10 pop artists is made. Each person votes for an artist by specifying the number of the artist (a value from 1 to 10). Develop a Julia program to read the names of the artists, followed by the votes, and find out which artist is the most popular. [Refer Book 1: Chapter 7]
7	a. Given a line of text as input, develop a Julia program to determine the frequency with which each letter of the alphabet is used (make use of dictionary) b. Develop a Julia program to fetch words from a file with arbitrary punctuation and keep track of all the different words found (make use of set and ignore the case of the letters: e.g. to and To are treated as the same word). [Refer Book 1: Chapter 10]
8	a. Develop a Julia program to evaluate expressions consisting of rational, irrational number and floating point numbers) b. Develop a Julia program to determine the following properties of a matrix: determinant, inverse, rank, upper & lower triangular matrix, diagonal elements, Euclidean norm and Square Root of a Matrix. [Refer Book 2: Chapter 5, 8]
9	a. Develop a Julia program to determine addition and subtraction of two matrices (element-wise). b. Develop a Julia program to perform multiplication operation on matrices: scalar multiplication, element-wise multiplication, dot product, cross product. [Refer Book 2: Chapter 8]

10	a. Develop a Julia program to generate a plot of (solid & dotted) a function: y=x2 (use suitable data points for x). b. Develop a Julia program to generate a plot of mathematical equation: y = sin(x) + sin(2x). c. Develop a Julia program to generate multiple plots of mathematical equations: y = sin(x) + sin(2x) and y= sin(2x) + sin(3x). [Refer Book 2: Chapter 13]

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Apply concepts of data-types, selection and looping constructs of Julia programming language.
CO2	Demonstrate the use of strings, functions, arrays and matrix operations in solving problems.
CO3	Develop programs involving data structures to handle multi-valued data items.
CO4	Make use of packages to generate plots of mathematical functions and equations.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/ PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2			1	1								1		
CO2		2		2	1								1	1	
CO3	2				1								1	1	
CO4	2			2	1								1	2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.4

Semester End Examination (SEE): Refer Annexure-1 Sl. No.4

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Julia – Bit by Bit (Programming for Beginners)	Noel Kalicharan	2021	Springer

VII(b): Reference Books:

1	Beginning Julia Programming (For Engineers and Scientists)	Sandeep Nagar	2017.	Apress-Springer

VII(c): Web links and Video Lectures (e-Resources):

3. https://doi.org/10.1007/978-3-030-73936-2
4. https://doi.org/10.1007/978-1-4842-3171-5

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	AEC		
Course Title: GREEN IT					
Course Code:	**23AIAE52**			**Credits:**	1
Teaching Hours/Week (L: T:P:O) (O – Other pedagogies, mention @)			0:1:0:0	**Total Hours:**	15
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03
Pre-requisite: Green IT practices, SDG Awareness and Project management skills.					

I. Course Objectives:

- Understand challenges for Green ICT and the environmental impact.
- Learn different aspects of ICT metrics and Sustainable Cloud Computing.
- Explore effects of software design on the Sustainability.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Module-1 Green ICT	3 Hrs.

Green ICT -History, Agenda, and Challenges Ahead: Introduction, Industrial Revolution, The Emergence of Information and Communication Technologies, The Agenda and Challenges Ahead.

RBT Levels: L1, L2

Module-2 Emerging Technologies and their Environmental Impact	3 Hrs.
Emerging Technologies and Their Environmental Impact: Introduction, Number of Connected Devices, Increased, Functionality, Increased Number of Separate Functions, Increased Demand for Speed and Reliability, Obsolescence—The Problem of Backward Compatibility, The Other Side of the Balance Sheet, Videoconference as an Alternative to Business Travel, Dematerialization of Product Chain, Applications.	
RBT Levels: L1, L2, L3	
Module-3 Measurements and Sustainability	3 Hrs.
Introduction, ICT Technical Measures, Ecological Measures and Ethical Consideration, Systems Engineering for Designing Sustainable ICT-Based Architectures.	
RBT Levels: L1, L2	
Module-4 Sustainable Cloud Computing	3 Hrs.
Introduction, Challenges in the use of Cloud Computing as Green Technology, Cloud Computing and Sustainability, Sustainable Applications of Cloud Computing, Technologies Associated with Sustainable Cloud Computing, Reflections on Sustainable Cloud Computing Applications.	
RBT Levels: L1, L2	
Module-5 Sustainable Software Design	3 Hrs
Overview and Scope, Evaluating Sustainability Effects, Sustainability and the Product Life Cycle, Direct Effects: Sustainability During Use, Runtime Energy Consumption Basics, Analyzing the Energy Consumption of an Application, Energy Consumption Reduction Using Physical Properties of Semiconductors, Optimizing the Energy Consumption of an Application: Compiler Techniques & Runtime Approaches.	
RBT Levels: L1, L2, L3	

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Classify the challenges for Green ICT
CO2	Relate the environmental impact due to emerging technologies.
CO3	Demonstrate different aspects of ICT metrics.
CO4	Compare the various parameters related to Sustainable Cloud Computing.
CO5	Interpret the effects of software design on the sustainability.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1		2					3						2		
CO2						2	3						2	2	
CO3		2					2					1		2	
CO4							3					1		3	
CO5							3						2	3	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.4

Semester End Examination (SEE): Refer Annexure-1 Sl. No.4

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Green Information Technology – A Sustainable Approach	Mohammad Dastbaz Colin Pattinson, Babak Akhgar	2015	Elsevier

VII(b): Reference Books:

1	Harnessing Green IT: Principles and Practices	San Murugesan; G. R. Gangadharan	2012	Wiley-IEEE Press

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=kvn_-mJ2tSo
- https://www.youtube.com/watch?v=kxngsYn5N3Y
- https://www.youtube.com/watch?v=EgdFi3sCgzU
- https://www.brightest.io/sustainability-measurement
- https://www.youtube.com/watch?v=S2m49Op25Zw

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	**AEC**		
Course Title: R Programming					
Course Code:	**23AIAE53**			**Credits:**	1
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			0:0:2:0	**Total No. of Lab Slots:**	12
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Lab**			**Exam Hours:**	03
Pre- Prerequisite: Statistics, Data handling, Logical thinking.					

I. Course Objectives:

- To explore and understand how R and R Studio interactive environment.
- To understand the different data Structures, data types in R.
- To learn and practice programming techniques using R programming.
- To import data into R from various data sources and generate visualizations.
- To draw insights from datasets using data analytics techniques.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Sl. No.	List of Laboratory Experiments
1	Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors.

<table>
<tr><td></td><td>d) Demonstrate Creation of Matrices
e) Demonstrate the Creation of Matrices from Vectors using Binding Function.
f) Demonstrate element extraction from vectors, matrices and arrays
Suggested Reading – Text Book 1 – Chapter 1 (What is R, Installing R, Choosing an IDE – RStudio, How to Get Help in R, Installing Extra Related Software), Chapter 2 (Mathematical Operations and Vectors, Assigning Variables, Special Numbers, Logical Vectors), Chapter 3 (Classes, Different Types of Numbers, Other Common Classes, Checking and Changing Classes, Examining Variables)</td></tr>
<tr><td>2</td><td>Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics:
a. Profit for each month.
b. Profit after tax for each month (Tax Rate is 30%).
c. Profit margin for each month equals to profit after tax divided by revenue.
d. Good Months – where the profit after tax was greater than the mean for the year.
e. Bad Months – where the profit after tax was less than the mean for the year.
f. The best month – where the profit after tax was max for the year.
g. The worst month – where the profit after tax was min for the year.
Note:
a. All Results need to be presented as vectors
b. Results for Dollar values need to be calculated with $0.01 precision, but need to be presented in Units of $1000 (i.e 1k) with no decimal points
c. Results for the profit margin ratio need to be presented in units of % with no decimal point.
d. It is okay for tax to be negative for any given month (deferred tax asset)
e. Generate CSV file for the data.
Suggested Reading – Text Book 1 – Chapter 4 (Vectors, Combining Matrices)</td></tr>
<tr><td>3</td><td>Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication
Suggested Reading – Text Book 1 – Chapter 4 (Matrices and Arrays – Array Arithmetic)</td></tr>
<tr><td>4</td><td>Develop a program to find the factorial of given number using recursive function calls. Suggested Reading – Reference Book 1 – Chapter 5 (5.5 – Recursive Programming) Text Book 1 – Chapter 8 (Flow Control and Loops – If and Else, Vectorized If, while loops, for loops), Chapter 6 (Creating and Calling Functions, Passing Functions to and from other functions)</td></tr>
<tr><td>5</td><td>Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.
Suggested Reading – Reference Book 1 - Chapter 5 (5.5 – Recursive Programming) Text Book 1 – Chapter 8 (Flow Control and Loops – If and Else, Vectorized If, while loops, for loops), Chapter 6 (Creating and Calling Functions, Passing Functions to and from other functions)</td></tr>
<tr><td>6</td><td>The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to: a) Find the Pearson and Spearman correlation coefficients. Are they similar? b) Plot the data using the plot command. c) Plot the logarithm (log) of each variable and see if that makes a difference.
Suggested Reading – Text Book 1 –Chapter 12 – (Built-in Datasets) Chapter 14 – (Scatterplots) Reference Book 2 – 13.2.5 (Covariance and Correlation)</td></tr>
<tr><td>7</td><td>Develop R program to create a Data Frame with following details and do the following operations.
<table>
<tr><th>Item Code</th><th>Item Category</th><th>Item Price</th></tr>
<tr><td>1001</td><td>Electronics</td><td>700</td></tr>
<tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr>
<tr><td>1003</td><td>Office Supplies</td><td>350</td></tr>
<tr><td>1004</td><td>USB</td><td>400</td></tr>
<tr><td>1005</td><td>CD Drive</td><td>800</td></tr>
</table>
a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames
Suggested Reading –Textbook 1: Chapter 5 (Lists and Data Frames)</td></tr>
</table>

8	Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements. a) Assigning names, using the air quality data set. b) Change colors of the Histogram c) Remove Axis and Add labels to Histogram d) Change Axis limits of a Histogram e) Add Density curve to the histogram **Suggested Reading** –Reference Book 2 – Chapter 7 (7.4 – The ggplot2 Package), Chapter 24 (Smoothing and Shading)
9	Design a data frame in R for storing about 20 employee details. Create a CSV file named "input.csv" that defines all the required information about the employee such as id, name, salary, start date, dept. Import into R and do the following analysis. a) Find the total number rows & columns b) Find the maximum salary c) Retrieve the details of the employee with maximum salary d) Retrieve all the employees working in the IT Department. e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file "output.csv" **Suggested Reading** – Text Book 1 – Chapter 12(CSV and Tab Delimited Files)
10	Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburettors Develop R program, to solve the following: a) What is the total number of observations and variables in the dataset? b) Find the car with the largest hp and the least hp using suitable functions) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness? d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations. e) Which pair of variables has the highest Pearson correlation?

Instructions for conduction of practical part:

- **LAB Activities:** Conduct laboratory exercises, prepare lab reports, observations and analyze results, perform lab tests, and work on design and implementation tasks.
- **Experiential Learning**: Students will be evaluated based on their creativity and practical problem-solving skills. This includes program-specific requirements and video-based seminars, presentations, or demonstrations.

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Explain the fundamental syntax of R data types, expressions and the usage of the R-Studio IDE
CO2	Develop a program in R with programming constructs: conditionals, looping and functions.
CO3	Apply the list and data frame structure of the R programming language.
CO4	Use visualization packages and file handlers for data analysis.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	2			3								3	2	
CO2	3	3	3		2								3		
CO3	2	2			2								2	2	
CO4		3		3	3									3	3

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.4

Semester End Examination (SEE): Refer Annexure-1 Sl. No.4

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Learning R: A Step by Step Function Guide to Data Analysis	Cotton, R	1st edition 2013	O'Reilly Media Inc

VII(b): Reference Books: (Insert or delete rows as per requirement)

1	Introduction to Scientific Programming and Simulation Using R.	Jones, O., Maillardet. R. and Robinson	2014	Chapman & Hall/CRC, The R Series
2	The Book of R: A First Course in Programming and Statistics	Davies, T.M	2016	Statistics. No Starch Press

VII(c): Web links and Video Lectures (e-Resources):

- https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html
- https://www.w3schools.com/r/r_stat_data_set.asp
- https://rpubs.com/BillB/217355

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

For the above experiments, the following pedagogical approaches can be considered: Problem-based learning, Active learning, MOOCs, and Chalk & Talk.

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	V	**Course Type:**	AEC		
Course Title:	**Technical Writing using LaTeX**				
Course Code:	**23AIAE54**			**Credits:**	1
Teaching Hours/Week (L: T:P:O) (O – Other pedagogies, mention @)			0:0:2:0	**Total No of Lab Slots:**	12
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Lab			**Exam Hours:**	03

Pre-requisite: Basic computer skills, familiarity with text editors and understanding of document structure

I. Course objectives:

- To introduce the basic syntax and semantics of the LaTeX scripting language
- To understand the presentation of tables and figures in the document
- To illustrate the LaTeX syntax to represent the theorems and mathematical equations
- To make use of the libraries (Tikz, algorithm) to design the diagram and algorithms in the document

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

□ Chalk & Talk □ Stud. Assignment □ Web Resources □ LCD/Smart Boards □ Stud. Seminars

III. COURSE CONTENT

Sl. No.	Experiments
1	Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with dummy text in each section. And also include header [title of document] and footer [institute name, page number] in the document.
2	Develop a LaTeX script to create a document that displays the Sample Abstract/Summary
3	Develop a LaTeX script to create a simple title page of the Sample project Report [Use suitable Logos and text formatting]
4	Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry]

5 Develop a LaTeX script to create a document that contains the following table with proper labels.

Sl.No.	EMP_ID	EMP_NAME	EMP_SALES_INFO			
			Q 1	Q 2	Q 3	Q 4
1	A25XX01	Name 1	89	80	90	73
2	B25XX02	Name 2	78	85	98	65
3	C25XX03	Name 3	67	75	59	92

6 Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept

7 Develop a LaTeX script to create a document that consists of the following two mathematical equations.

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$= \frac{-2 \pm \sqrt{2^2-4*(1)*(-8)}}{2*1}$$

$$= \frac{-2 \pm \sqrt{4+32}}{2}$$

$$\varphi_\sigma^\lambda A_t = \sum_{\pi \in C_t} \operatorname{sgn}(\pi)\varphi_\sigma^\lambda \varphi_\pi^\lambda$$

$$= \sum_{\tau \in C_{\sigma t}} \operatorname{sgn}(\sigma^{-1}\tau\sigma)\varphi_\sigma^\lambda \varphi_{\sigma^{-1}\tau\sigma}^\lambda$$

$$= A_{\sigma t}\varphi_\sigma^\lambda$$

8 Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document

9 Develop a LaTeX script to design a simple tree diagram or hierarchical structure in the document with appropriate labels using the Tikz library

10 Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Apply basic LaTeX command to develop simple document
CO2	Develop LaTeX script to present the tables and figures in the document
CO3	Illustrate LaTeX script to present theorems and mathematical equations in the document
CO4	Develop programs to generate the complete report with citations and a bibliography
CO5	Illustrate the use of Tikz and algorithm libraries to design graphics and algorithms in the document

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	2	-	-	-	-	-	-	-	1	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	1	-	-	3	-	-
CO3	3	1	-	-	-	-	-	-	-	2	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	2	-	-	3	2	-
CO5	3	2	-	-	-	-	-	-	-	3	-	-	3	3	-

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.4

Semester End Examination (SEE): Refer Annexure-1 Sl. No.4

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	A Short Introduction to LaTeX	FIRUZA KARMALI (AIBARA)	2019	CreateSpace independent publishing platform

2.	Formatting Information: A Beginner's Introduction to Typesetting with LaTeX	PETER FLYNN	2015	Comprehensive TeX Archive Network

VII(b): Web links and Video Lectures (e-Resources):

- LaTeX TUTORIAL: [https://latex-tutorial.com/tutorials/]
- LaTeX TUTORIAL: [https://www.javatpoint.com/latex]

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	PCC		
Course Title: Language Translation Techniques					
Course Code:	**23AIT601**			**Credits:**	3
Teaching Hours/Week (L: T: P: O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	03

Pre prerequisite: Basic knowledge of programming languages and data structures.

I. Course Objectives:

- This course introduces compiler design, covering essential components like lexical analysis, parsing, intermediate code generation, and code optimization.
- Students will learn the differences between compilers, interpreters, and assemblers, explore the phases of a compiler, and develop skills in designing lexical analyzers and parsers.
- The course also addresses intermediate code generation, optimization techniques, and the basics of code generation, equipping students with the tools needed to build and understand a simple compiler.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

☐ Chalk & Talk ☐ Stud. Assignment ☐ Web Resources ☐ LCD/Smart Boards ☐ Stud. Seminars

III. COURSE CONTENT

Module-1: Introduction	8 Hrs

Overview of the Translation Process, A Simple Compiler, Difference between interpreter, assembler and compiler. Overview and use of linker and loader, types of Compilers, Analysis of the Source Program, The Phases of a Compiler, Cousins of the Compiler, The Grouping of Phases, Lexical Analysis, Hard Coding and Automatic Generation Lexical Analyzers, Front-end and Back-end of compiler, pass structure

RBT Levels: L1, L2, L3

Module-2: Lexical Analyzer	8 Hrs

Lexical Analyzer: Introduction to Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A Language for Specifying Lexical Analyzers, Finite Automata from a Regular Expression, Design of a Lexical Analyzer Generator, Optimization of DFA

RBT Levels: L1, L2, L3

Module-3: Parsing Theory	8 Hrs

Top Down and Bottom-up Parsing Algorithms, Top-Down Parsing, Bottom-Up Parsing, Operator-Precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators, Automatic Generation of Parsers. Syntax-Directed Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S- Attributed Definitions, L-Attributed Definitions, syntax directed definitions and translation schemes

RBT Levels: L1, L2, L3

Module-4: Intermediate Code Generation & Optimization	8 Hrs

INTERMEDIATE CODE GENERATION: Variants of syntax trees; Three-address code; Types and declarations; Translation of expressions; Type checking; Control flow; **Code Optimization:** Global Data Flow Analysis, A Few Selected Optimizations like Command Sub Expression Removal, Loop Invariant Code Motion, Strength Reduction.

RBT Levels: L1, L2, L3

Module-5: Code Generation	8 Hrs

Code Generation: Issues in the Design of a Code Generator, The Target Machine, Basic Blocks and Flow Graphs, Next-Use Information, A Simple Code Generator, Register Allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs,

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Understand the key concepts of compiler design, including lexical analysis, parsing, and code generation.
CO2	Create a lexical analyzer and parser for a simple programming language
CO3	Apply optimization techniques to improve intermediate code.
CO4	Generate intermediate code and perform type checking.
CO5	Implement code generation strategies for efficient machine-level code.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1		2										2		
CO2	2	3		1									1		
CO3	2		1		1								2		
CO4	1			2											
CO5		2	2												

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Compilers- Principles, Techniques and Tools	Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman	2nd Edition, 2007.	Addison-Wesley

VII(b): Reference Books:

1	Crafting a Compiler with C	Charles N. Fischer, Richard J. leBlanc, Jr.,	1991	Pearson Education,
2	Modern Compiler Implementation in C	Andrew W	1997	Apple Cambridge University Press
3	Compiler Construction Principles & Practice	Kenneth C Louden	1997	Thomson Education

VII(c): Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/compiler-design/
- https://www.youtube.com/watch?v=O3IHF7TZhT4
- https://www.coursera.org/learn/compilers
- https://www.youtube.com/watch?v=F3Ue_LM_Jq0
- https://www.cs.princeton.edu/~appel/modern/c/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	IPCC		
Course Title: Natural Language Processing					
Course Code:	**23AII602**			**Credits:**	04
Teaching Hours/Week (L: T: P: O)			3:0:2:0	**Total Hours:**	40+10 slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre prerequisite: Basic programming (especially Python), familiarity with data structures and algorithms, and a fundamental understanding of statistics and probability.

I. Course Objectives:

- This course aims to provide a comprehensive understanding of natural language modeling and its significance in various fields.
- Students will explore the diverse applications of natural language processing (NLP) and gain insights into methods for spelling error detection and correction. Additionally, the course covers parsing techniques essential for processing natural language, along with information retrieval models that are key to effectively searching and organizing language data.
- Through these topics, learners will develop a strong foundation in the core aspects of NLP.

II. Teaching-Learning Process:

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

☐ Chalk & Talk ☐ Stud. Assignment ☐ Web Resources ☐ LCD/Smart Boards ☐ Stud. Seminars

III COURSE CONTENT	
III(a). Theory PART	
Module-1: Introduction and Language	**8 Hrs**
Introduction: What is Natural Language Processing? Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications. **Language Modeling:** Statistical Language Model - N-gram model (unigram, bigram), Paninion Framework, Karaka theory. **Textbook 1: Ch. 1, Ch. 2.**	
RBT Levels: L1, L2, L3	
Module-2: Word Level Analysis	**8 Hrs**
Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of Speech Tagging. Syntactic Analysis: Context-Free Grammar, Constituency, Top-down and Bottom-up Parsing, CYK Parsing. **Textbook 1: Ch. 3, Ch. 4**.	
RBT Levels: L1, L2, L3	
Module-3: Naive Bayes, Text Classification and Sentiment	**8 Hrs**
Naive Bayes, Text Classification and Sentiment: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked Example, Optimizing for Sentiment Analysis, Naive Bayes for Other Text Classification Tasks, Naive Bayes as a Language Model. **Textbook 2: Ch. 4.**	
RBT Levels: L1, L2, L3	
Module-4: Information Retrieval	**8 Hrs**
Information Retrieval: Design Features of Information Retrieval Systems, Information Retrieval Models - Classical, Non-classical, Alternative Models of Information Retrieval - Custer model, Fuzzy model, LSTM model, Major Issues in Information Retrieval. Lexical Resources: WordNet, FrameNet, Stemmers, Parts-of-Speech Tagger, Research Corpora. **Textbook 1: Ch. 9, Ch. 12.**	
RBT Levels: L1, L2, L3	
Module-5: Machine Translation	**8 Hrs**
Machine Translation: Language Divergences and Typology, Machine Translation using Encoder Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation, Bias and Ethical Issues. **Textbook 2: Ch. 13.**	
RBT Levels: L1, L2, L3	

III(b). PRACTICAL PART.

Sl. No.	Experiments
1	Write a Python program for the following preprocessing of text in NLP: • Tokenization • Filtration • Script Validation • Stop Word Removal • Stemming
2	Demonstrate the N-gram modeling to analyze and establish the probability distribution across sentences and explore the utilization of unigrams, bigrams, and trigrams in diverse English sentences to illustrate the impact of varying n-gram orders on the calculated probabilities.

3	Investigate the Minimum Edit Distance (MED) algorithm and its application in string comparison and the goal is to understand how the algorithm efficiently computes the minimum number of edit operations required to transform one string into another. • Test the algorithm on strings with different type of variations (e.g., typos, substitutions, insertions, deletions) • Evaluate its adaptability to different types of input variations
4	Write a program to implement top-down and bottom-up parser using appropriate context free grammar.
5	Given the following short movie reviews, each labeled with a genre, either comedy or action: • fun, couple, love, love comedy • fast, furious, shoot action • couple, fly, fast, fun, fun comedy • furious, shoot, shoot, fun action • fly, fast, shoot, love action • A new document D: fast, couple, shoot, fly Compute the most likely class for D. Assume a Naive Bayes classifier and use add-1 smoothing for the likelihoods. 6 Demonstrate the following
6	Write a Python program to find synonyms and antonyms of the word "active" using WordNet.
7	Implement the machine translation application of NLP where it needs to train a machine translation model for a language with limited parallel corpora. Investigate and incorporate techniques to improve performance in low-resource scenarios.

Instructions for conduction of practical part:

- **LAB Activities:** Conduct laboratory exercises, prepare lab reports, observations and analyze results, perform lab tests, and work on design and implementation tasks.
- **Experiential Learning**: Students will be evaluated based on their creativity and practical problem-solving skills. This includes program-specific requirements and video-based seminars, presentations, or demonstrations.

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	**Apply** the basic concepts of NLP, including grammar-based and statistical language models.
CO2	**Implement** morphological analysis using Finite State Transducers and parse text with context-free grammar and various parsing techniques.
CO3	**Develop** a Naïve Bayes classifier and perform sentiment analysis for text classification and natural language tasks.
CO4	**Apply** the concepts of information retrieval techniques, lexical semantics, and tools like WordNet to explore word meanings and distributional similarity.
CO5	**Explore** machine translation applications in NLP using encoder-decoder models.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2												2		
CO2	2	2											2	1	
CO3	2	2			1								2		
CO4	2		2		2								1	1	
CO5	1			2									1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.2

Semester End Examination (SEE): Refer Annexure-1 Sl.No.2

VII. Learning Resources

VII(a): Textbooks

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U.S. Tiwary,	2020	Oxford University Press.
2	Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition	Daniel Jurafsky, James H. Martin,	2023	Pearson Education

VII(b): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python	Akshay Kulkarni, Adarsha Sivananda,	2019	Apress
2	Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives	T V Geetha	2024	Pearson

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=M7SWr5xObkA
- https://youtu.be/02QWRAhGc7g
- https://www.youtube.com/watch?v=CMrHM8a3hqw
- https://onlinecourses.nptel.ac.in/noc23_cs45/preview
- https://archive.nptel.ac.in/courses/106/106/106106211/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes, Seminar and Mini Project

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	**PCCL**		
Course Title: Language Translation Techniques lab					
Course Code:	**23AIL603**			**Credits:**	1
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			0:0:2:0	**Total No of Lab Slots:**	12
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Lab**			**Exam Hours:**	03

Pre-Prerequisite: Basic understanding of programming (preferably in C/C++ or Python) and familiarity with data structures and algorithms.

I. Course Objectives:

- This course aims to equip students with the skills to design and implement core components of a compiler, such as lexical analyzers and tokenizers, for identifying tokens in source code.
- Students will learn various parsing techniques, including LL(1) and shift-reduce parsing, to evaluate and process expressions.
- Additionally, the course covers building symbol tables for managing program identifiers and implementing tools for syntax checking, providing a comprehensive understanding of compiler design and language processing.

II. Teaching-Learning Process (General Instructions):

- List of problems for which students should develop and execute programs in the laboratory using Python/C/C++ programming languages

COURSE CONTENTS

Sl. No.	Laboratory Experiments
1	**Lexical Analyzer (Scanner)**: Design a lexical analyzer to identify tokens in a given source code.
2	**Tokenizer**: Write a program to break a string of code into its constituent parts (keywords, operators, identifiers, etc.).
3	**Expression Evaluator**: Design a program to evaluate arithmetic expressions using a stack-based approach.
4	**Simple Calculator**: Implement a calculator that parses and evaluates basic arithmetic expressions.
5	**Parenthesis Matching**: Write a program to check for balanced parentheses in a mathematical expression.
6	**Symbol Table Implementation**: Create a symbol table for storing variable names, data types, and values.
7	**Simple Syntax Checker**: Implement a program to check if a given code snippet follows the correct syntax.
8	**Parser Techniques**: Construct an LL(1) parser for an expression
9	**Parser Techniques:** Develop an operator precedence parser for a given language.
10	**Parser Techniques**: Implementation of shift reduce parsing algorithm.

Instructions for conduction of practical part:

- **LAB Activities:** Conduct laboratory exercises, prepare lab reports, observations and analyze results, perform lab tests, and work on design and implementation tasks.
- **Experiential Learning**: Students will be evaluated based on their creativity and practical problem-solving skills. This includes program-specific requirements and video-based seminars, presentations, or demonstrations.

III. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	**Design lexical analyzers** to identify tokens in source code and tokenize input data.
CO2	**Implement parsing techniques** like LL(1) and shift-reduce to evaluate and process expressions.
CO3	**Create and manage symbol tables** and build tools for syntax checking in code.

IV. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/ PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1		3										2	1	
CO2		2	2	2									1	2	
CO3			1		2										

V. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.4

Semester End Examination (SEE): Refer Annexure-1 Sl.No.4

VI. Learning Resources

VII(a): Textbooks: (Insert or delete rows as per requirement)

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Compilers- Principles, Techniques and Tools	Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman	2nd Edition, 2007.	Addison-Wesley

VII(b): Reference Books: (Insert or delete rows as per requirement)

1	Modern Compiler Implementation in C	Andrew W	1997	Apple Cambridge University Press

VII(c): Web links and Video Lectures (e-Resources):

https://www.youtube.com/playlist?list=PLUl4u3cNGP60U5uPbGU39X3Iau_YTUNxJ
https://www.youtube.com/playlist?list=PLZyVg-y6I2sqVuRo47zlm61cQ7nToqT5v
https://www.youtube.com/playlist?list=PLJ9mH2YkjlJ8sIuOXjh82IuAtxaMI-QhT

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

For the above experiments, the following pedagogical approaches can be considered: Problem-based learning, Active learning, MOOCs, and Chalk & Talk.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	PEC		
Course Title: Introduction to Vector Database					
Course Code:	**23AIP621**			**Credits:**	3
Teaching Hours/Week (L: T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic knowledge of databases, Machine learning concepts, and Python programming

I. Course Objectives:

- This course aims to provide a comprehensive understanding of vector databases, their architecture, and their applications in AI and machine learning.
- Students will learn about vector embeddings, indexing techniques, and efficient querying methods like k-NN and ANN.
- The course covers practical integration with ML models, real-world use cases in search, recommendation systems, and NLP, and essential considerations like security, ethics, and future advancements.
- By the end, students will gain hands-on experience and the ability to implement vector databases in AI-driven applications.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

☐ Chalk & Talk ☐ Stud. Assignment ☐ Web Resources ☐ LCD/Smart Boards ☐ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1: Introduction to Vector Databases	8 Hrs

I**ntroduction to Vector Databases**: Why do we need vector databases? A new data type, VECTOR: What's different about the VECTOR type?, Where do we use vector databases? ,**SQL vs. Vector Databases**: The Foundation of Business Math: Accounting Arithmetic, Vector Representation in RDBMS, The Need for Vector-Specific Capabilities, **NoSQL vs. Vector Databases**: NoSQL Databases and Vector Storage, Limitations of Vector Extensions in NoSQL Databases, When to Choose NoSQL with Vector Extensions **Hybrid Approaches**: Combining Structured and Vector Data, The Need for Both Vector and Metadata Limitations of Pure Vector Storage, Hybrid Database Architecture, Example of a Hybrid Query Benefits of the Hybrid Approach

Textbook 1: Chapter 1

RBT Levels: L1, L2, L3

Module-2: Vector Embeddings	8 Hrs

Understanding Vector Embeddings: Why We Need The, Word2Vec: The Breakthrough That Changed Everything, Doc2Vec: From Words to Documents, From Embeddings to Modern Language Models: The Transformer Connection, Encoder-Only Transformers (BERT and Its Variants), Decoder-Only Transformers (GPT Family), Embedding Models: The Specialized Vector Generators, The Distinction from Traditional Models, Role in Modern LLM Applications, Practical Applications and Use Cases

Textbook 1: Chapter 2

RBT Levels: L1, L2, L3

Module-3: Reimagining Data for AI	8 Hrs

The Problem with Specialty Vector Databases, **Managing** Traditional Data, Using Contextual Data for AI, Recognizing the Key, Characteristics to Support AI and Vector Workloads: Understanding Different Forms of Search, The Non-Negotiables of a Hybrid, Search System,

Textbook 2: Chapter 2 & 3

RBT Levels: L1, L2, L3

Module-4: Diving into SingleStoreDB	8 Hrs

Introducing SingleStoreDB: Supporting Vectors, VECTOR JOINS, Getting Vectors into SingleStoreDB, Nearest-neighbor search in SQL, Hybrid nearest-neighbor/metadata, vector search in SQL, Mixing full-text and vector search

Textbook 2: Chapter 4

RBT Levels: L1, L2, L3

Module-5: Looking into Agentic Apps and Their Use Cases	8 Hrs

Coding and Building Applications, Building Agentic Apps, Looking into Use Cases for Agentic Apps, Building an Application with SingleStoreDB, Setting Up the Business Problem, Using an Example Solution, Building a LangChain App with Vector Databases

Textbook 2: Chapter 5, Chapter- 6, Chapter - 7

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Understand the fundamentals of Vector Databases and their unique capabilities
CO2	Comprehend the concept of Vector Embeddings and their application in modern AI
CO3	Reimagine data handling and storage techniques to support AI workloads
CO4	Master Single StoreDB for vector storage and nearest-neighbor search functionality
CO5	Build and deploy Agentic Apps using vector databases

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2												1		
CO2		2											2		
CO3	2		2										1		
CO4		2											2		
CO5	2		2										1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Vector Databases	Nitin Borwankar	November 2025	O'Reilly Media, Inc. ISBN: 9781098177591
2	Vector Databases & AI Applications	Akmal Chaudhri, Arnaud Comet, Eric Hanson, and Madhukar Kumar	2024	**John Wiley & Sons**

VII(b): Reference Books:

1	Designing Data-Intensive Applications	Kleppmann, M.	2017	O'Reilly Media.
2	Programming machine learning: From coding to deep learning.	Perrotta, P.	2020	The Pragmatic Bookshelf
	AI-Powered Search	Doug Turnbull & Krishna Gade	2024	Manning

VII(c): Web links and Video Lectures (e-Resources):

- https://chatgpt.com/c/67a31eb7-61b0-800a-8062-0a6d2bd4341a#:~:text=large%20datasets.%0ALink%3A-,Vector%20Databases%3A%20From%20Embeddings%20to%20Applications,-Vector%20Database%20Fundamentals
- https://www.youtube.com/watch?v=dN0lsF2cvm4
- https://www.youtube.com/watch?v=8KrTO9bS91s
- https://www.youtube.com/watch?v=wc3Lh-eiNBM

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	PEC		
Course Title: Natural Computing					
Course Code:	**23AIP622**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: To succeed in the field of natural computing, a strong foundation in mathematics, computer science, and programming is crucial, along with an understanding of relevant scientific disciplines like physics and biology.

I. Course Objectives:

- The course objectives aim to provide a comprehensive understanding of Human-Centered AI (HCAI) by focusing on key principles and their practical applications.
- Students will learn the foundational concepts of HCAI, enabling them to evaluate and develop AI systems that are reliable, safe, and trustworthy through the HCAI framework.
- The course will also delve into governance strategies, teaching how to bridge the gap between ethical principles and practical implementation.
- Additionally, students will explore how organizations can foster safety cultures through effective management strategies, incident reporting, and trustworthy certification practices, while also understanding how AI can enhance human-to-human communication and cooperation.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Discuss how every concept can be applied to the real world –and when that's possible, it helps improve the students' understanding.
6. Use any of these methods: Chalk and board, Active Learning, Case Studies.

☐ Chalk & Talk ☐ Stud. Assignment ☐ Web Resources ☐ LCD/Smart Boards ☐ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1: Introduction to Natural Computing	8Hrs

From Nature-to-Nature Computing , Philosophy , Three Branches: A Brief Overview, Individuals, Entities and agents - Parallelism and Distributivity Interactivity ,Adaptation- Feedback-Self-Organization-Complexity, Emergence and, Bottom-up Vs Top-Down- Determination, Chaos and Fractals.

Textbook1: Chapter 2 Section 2.1 to 2.3

RBT Levels: L1, L2, L3

Module-2: Computing Inspired by Nature	8Hrs

Computing Inspired by Nature: Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Standard Evolutionary Algorithm -Genetic Algorithms.
Textbook1: Chapter 3 Section 3.1 to 3.5

RBT Levels: L1, L2,L3

Module-3: Reproduction-Crossover 8 Hrs

Reproduction-Crossover, Mutation, Evolutionary Programming, Genetic Programming . SWARM INTELLIGENCE: Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Clustering Algorithm (ACA).
Textbook1:Chapter 3: 3.6, Chapter 5: 5.1 to 5.5

RBT Levels: L1, L2, L3

Module-4: Immuno Computing 8 Hrs

Swarm Robotics, Foraging for food, Social Adaptation of Knowledge , Particle Swarm Optimization (PSO), Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding , Immune Network Theory- Danger Theory, Evaluation Interaction- Immune Algorithms.
Textbook2: Chapter 5: 5.3, 5.4, Chapter 6: 6.2, 6.3

RBT Levels: L1, L2, L3

Module-5: Governance Structures – 2 8 Hrs

Introduction – Bone Marrow Models , Forest's Algorithm, Artificial Immune Networks, Computing With New Natural Materials: DNA Computing: Motivation, DNA Molecule , Adleman's experiment , Test tube programming language.
Textbook1:Chapter 6: 6.4, 6.6, 6.7 Chapter 9: 9.1 to 9.3

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Realize and explain the fundamental concepts of **natural computing paradigms**
CO2	Implement and analyze **Genetic Algorithms, Particle Swarm Optimization, and Ant Colony Optimization** for solving optimization problems.
CO3	Apply **neurocomputing techniques**, including Artificial Neural Networks (ANN), to real-world problems.
CO4	Demonstrate the ability to use **bio-inspired models** in solving **complex engineering problems** and compare with traditional techniques.
CO5	Design and develop **intelligent systems** using natural computing principles for practical and research-oriented applications.

V. CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	2	1	1									1	2	
CO2	2	3	2	2									2	2	
CO3	2	2	3	3									2	2	2
CO4	1	1	3	3									2	2	2
CO5	2	2	1	2									1	2	1

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher

1	Fundamentals of Natural computing: basic concepts, Algorithms and Applications by Leandro Nunes de Castro	Leandro Nunes de Castro	First -2006	Chapman & Hall/CRC
VII(b): Reference Books:				
1	**Natural Computing Algorithms** By Anthony Brabazon, Michael O'Neill, Seán McGarraghy	By Anthony Brabazon, Michael O'Neill, Seán McGarraghy	First 2015	**Springer**

VII(c): Web links and Video Lectures (e-Resources):

- https://freevideolectures.com/course/4639/nptel-cloud-computing/1.
- https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
- https://www.youtube.com/watch?v=EN4fEbcFZ_E
- https://www.youtube.com/watch?v=RWgW-CgdIk0
- https://www.geeksforgeeks.org/virtualization-cloud-computing-types

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	PEC		
Course Title: Human-Centered AI					
Course Code:	**23AIP623**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic understanding of artificial intelligence and foundational knowledge of ethics in technology.

I. Course Objectives:

- The course objectives aim to provide a comprehensive understanding of Human-Centered AI (HCAI) by focusing on key principles and their practical applications.
- Students will learn the foundational concepts of HCAI, enabling them to evaluate and develop AI systems that are reliable, safe, and trustworthy through the HCAI framework.
- The course will also delve into governance strategies, teaching how to bridge the gap between ethical principles and practical implementation.
- Additionally, students will explore how organizations can foster safety cultures through effective management strategies, incident reporting, and trustworthy certification practices, while also understanding how AI can enhance human-to-human communication and cooperation.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

☐ Chalk & Talk ☐ Stud. Assignment ☐ Web Resources ☐ LCD/Smart Boards ☐ Stud. Seminars

III. COURSE CONTENT

Theory

Module-1: What Is Human-Centered Artificial Intelligence	8 Hrs
What is Human-Centered Artificial Intelligence: Introduction, Are People And Computers In The Same Category?, Will Automation, AI, And Robots Lead To Widespread Unemployment? **Textbook: Chapter 1, Chapter 3, Chapter 4 M**	
RBT Levels: L1, L2, L3	
Module-2: Human-Centered Ai Framework	8Hrs
Human-Centered Ai Framework: Introduction, Defining Reliable, Safe, and Trustworthy Systems, Two-Dimensional HCAI Framework, Design Guidelines and Examples **Textbook: Chapter 6, Chapter 7, Chapter 8, Chapter 9**	
RBT Levels: L1, L2,L3	
Module-3: Design Metaphors	8 Hrs
Design Metaphors: Introduction, Science and Innovation Goals, Intelligent Agents and Super tools, Teammates and Tele-bots, Social Robots and Active Appliances **Textbook: Chapter 11, Chapter 12, Chapter 13, Chapter 14, Chapter 16**	
RBT Levels: L1, L2, L3	
Module-4: Governance Structures – 1	8 Hrs
Governance Structures – 1: Introduction, Reliable Systems Based on Sound Software Engineering Practice, Safety Culture through Business Management Strategies, Trustworthy Certification by Independent Oversight **Textbook: Chapter 18, Chapter 19, Chapter 20, Chapter 21**	
RBT Levels: L1, L2, L3	
Module-5: Governance Structures – 2	8 Hrs
Governance Structures – 2: Government Interventions and Regulations, Introduction: Driving HCAI Forward, Assessing Trustworthiness, caring for and Learning from Older Adults **Textbook: Chapter 22, Chapter 24, Chapter 25, Chapter 26**,	
RBT Levels: L1, L2, L3	

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Realize the basics of Human-Centered AI, focusing on values like rights, dignity, and justice
CO2	Utilize the Human-Centered AI framework to create AI systems that balance human control and automation.
CO3	Apply design ideas like super tools and tele-bots to create AI applications that boost human creativity.
CO4	Develop rules and ethical plans to ensure AI systems are used safely and responsibly.
CO5	Recognize new trends and challenges in Human-Centered AI and find ways to improve trust and benefit society.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2												2		1
CO2	2		1										1	2	
CO3			2		3								1		
CO4	1		1			1		2							
CO5	1														2

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Human-centered AI.	Shneiderman, Ben.	2nd Edition, 2022.	Oxford University Press
VII(b): Reference Books:				
1	Human-Centered Artificial Intelligence: Research and Applications.	Nam, Chang S., Jae-Yoon Jung, and Sangwon Lee	2nd Edition 2022.	Academic Press,
2	Human-centered artificial intelligence: Advanced lectures.	Chetouani, Mohamed, et al.,	2023.	vol. 13500. Springer Nature,

VII(c): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/playlist?app=desktop&list=PL2ovtN0KdWZiBkaQsHXMGFTEzok7YQkvt
- https://www.youtube.com/watch?v=HcCZSw-Rm-w

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	PEC		
Course Title: Distributed Systems					
Course Code:	**23AIP624**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic knowledge of computer networks, operating systems, and programming concepts.

I. Course Objectives:

- This course aims to provide students with a comprehensive understanding of the goals and challenges associated with distributed systems.
- Students will explore the architecture of key components such as RPC/RMI, distributed file systems, and name services.
- The course will also cover clock synchronization algorithms, mutual exclusion, election, and consensus algorithms, as well as fundamental concepts and algorithms related to distributed transactions and replication.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT

Theory

Module-1: CHARACTERIZATION OF DISTRIBUTED SYSTEMS	8 Hrs

CHARACTERIZATION OF DISTRIBUTED SYSTEMS: Introduction, Focus on resource sharing, Challenges. REMOTE INVOCATION: Introduction, Request-reply protocols, Remote procedure call, Introduction to Remote Method Invocation.
Textbook: Chapter- 1.1,1.4,1.5, 5.1-5.5

RBT Levels: L1, L2, L3

Module-2: DISTRIBUTED FILE SYSTEMS	8 Hrs

DISTRIBUTED FILE SYSTEMS: Introduction, File service architecture. NAME SERVICES: Introduction, Name services and the Domain Name System, Directory services.
Textbook: Chapter- 12.1,12.2, 13.1-13.3

RBT Levels: L1, L2,L3

Module-3: TIME AND GLOBAL STATES	8 Hrs

TIME AND GLOBAL STATES: Introduction, Clocks, events and process states, Synchronizing Physical clocks, Logical time and logical clocks, Global states
Textbook: Chapter- 14.1-14.5

RBT Levels: L1, L2, L3

Module-4: COORDINATION AND AGREEMENT	8 Hrs

COORDINATION AND AGREEMENT: Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems.
Textbook: Chapter -15.1-15.5

RBT Levels: L1, L2, L3

Module-5: DISTRIBUTED TRANSACTIONS	8 Hrs

DISTRIBUTED TRANSACTIONS: Introduction, Flat and nested distributed transactions, atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. **REPLICATION**: Introduction.
Textbook: Chapter -17.1-17.6, 18.1

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Identify the goals and challenges of distributed systems.
CO2	Demonstrate remote invocation techniques for communication.
CO3	Describe the architecture of distributed file systems and name services.
CO4	Apply clock synchronization algorithms to monitor and order events.
CO5	Analyze the performance of mutual exclusion, election, and consensus algorithms.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2	2					1						1		
CO2	2		2		2								1		
CO3	2	2	2												1
CO4	2	2		2	2									1	
CO5		2	2	2	1								1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No. 1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources				
VII(a): Textbooks:				
Sl. No.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the publisher**
1	Distributed Systems Concepts and Design	George Coulouris, Jean Dollimore and Tim Kindberg	Fifth Edition, 2012.	Pearson Education

VII(b): Reference Books:				
1	Distributed Computing: Principles, Algorithms, and Systems	Ajay D. Kshemkalyani, Mukesh Singhal	2008, 1st Edition	Cambridge University Press
VII(c): Web links and Video Lectures (e-Resources):				
• https://www.youtube.com/watch?v=Azyizl9w2xo&list=PLrjkTql3jnm9FEOXHA_qjRTMO DlaIk-W				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Assignments, Quizzes and Seminar.				

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	OEC		
Course Title: Introduction to Artificial Intelligence					
Course Code:	**23AIO611**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic understanding of programming concepts and algorithms.

I. Course Objectives:

- To understand the primitives of AI
- To familiarize Knowledge Representation Issues
- To understand fundamentals of Statistical Reasoning, Natural Language Processing.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT	
Theory	
Module 1:	8 Hrs

What is an Al Technique?,The Level of the Model, Criteria for Success, Some General References
Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs, Additional Problems

Textbook: Chapter 1: 1.3-1.6 ,Chapter 2-2. 1-2.6

RBT Levels: L1, L2, L3

Module-2:	8 Hrs

Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, The Frame Problem, Using Predicate Logic, Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Resolution, Natural Deduction, Summary, Exercises , Representing Knowledge Using Rules, Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge Exercises

Textbook: Chapter : 4. 1- 6.5

RBT Levels: L1, L2

Module-3:	8 Hrs

Introduction to Nonmonotonic Reasoning , Logics for Nonmonotonic Reasoning , Implementation Issues, Augmenting a Problem-solver , Implementation: Depth-first Search , Implementation: Breadth-first Search , Summary , Exercises , Statistical Reasoning, Probability and Bayes Theorem, Certainty Factors and Rule-based Systems , Bayesian Networks , Dempster-Shafer Theory, Fuzzy Logic

Textbook: Chapter : 7.1-8.5

RBT Levels: L1, L2

Module-4:	8 Hrs

Game Playing , Overview , The Minimax Search Procedure , Adding Alpha-beta Cutoffs , Additional Refinements, Iterative Deepening

NLP Introduction , Syntactic Processing , Semantic Analysis , Discourse and Pragmatic Processing , Statistical Natural Language Processing , Spell Checking Summary Exercises

Textbook: Chapter : 12.1-12.5, 15.1-15.6

RBT Levels: L1, L2

Module-5:	8 Hrs

Learning , What is Learning? , Rote Learning , Learning by Taking Advice , Learning in Problem-solving , Learning from Examples: Induction , Explanation-based Learning
Discovery , Analogy , Formal Learning Theory , Neural Net Learning and Genetic Learning

Representing and using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition-Summary Exercises

Textbook: Chapter : 17.1 -17.10 , 20.1-20.4

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Identify the problems where the adaptation of AI has significant impact
CO2	Analyse the different approaches of Knowledge Representation
CO3	Explain Symbolic Reasoning under Uncertainty and Statistical reasoning
CO4	Derive the importance of different types of Learning Techniques.
CO5	Explain Natural Language Processing and Expert System

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1	2													
CO2	2	1													
CO3	1	2	2												
CO4	2														
CO5	2			2											

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Artificial Intelligence	E. Rich, K. Knight & S. B. Nair	3rd Edition,2009	McGraw Hill

VII(b): Reference Books:

1	Artificial Intelligence: A Modern Approach	Stuart Rusell, Peter Norving	2nd Edition	Pearson Education
2	Introduction to Artificial Intelligence and Expert Systems	Dan W. Patterson	1st Edition,2015	Prentice Hal of India,
3	Artificial Intelligence: Structures and Strategies for complex problem Solving	G. Luger	4th Edition,2002	Pearson Education
4	Artificial Intelligence and Intelligent Systems	N.P. Padhy	2015	Oxford University Press

VII(c): Web links and Video Lectures (e-Resources):

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
- https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
- https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501595428077568125 59/overview

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Dept. of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	OEC		
Course Title: OOPS with C++					
Course Code:	**23AIO612**			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

VIII. Course Objectives:

- **Introduces Object Oriented Programming concepts using the C++ language.**
- **Implement classes, objects and functions using C++.**
- **Demonstrate the significance of constructors, destructor and operator overloading.**
- **Understanding the principles of inheritance.**
- **Apply the principles of virtual functions and polymorphism,**

IX. Teaching-Learning Process (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.
1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programming examples.

X. COURSE CONTENT

Module-1:	8Hours

An overview of C++: What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program.

Classes and Objects: Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment

Textbook:1 Chapters:11,12.

RBT Levels:L1,L2

Module-2:	8 Hours

Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, This Pointer, Pointers to derived types, Pointers to class members.

Functions Overloading, Copy Constructors: Functions Overloading, Overloading Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity.

Textbook:1 Chapters: 13,14.

RBT Levels:L1,L2

Module-3:	8 Hours

Operator Overloading: Creating a Member Operator Function, Operator Overloading Using a Friend Function, overloading new and delete

Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes.

Textbook: 1 Chapters: 15,16

RBT Levels:L1, L2

Module-4:	8 Hours

Virtual Functions and Polymorphism: Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical, Pure Virtual Functions, Using Virtual Functions, Early vs Late Binding.

Templates: Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates

Textbook:1 Chapters: 17,18.

RBT Levels:L1,L2,L3

Module-5:	8 Hours

Exception Handling: Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling.

File I/O: and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF.

Textbook:1 Chapters: 19,21.

RBT Levels:L1,L2,L3

XI. COURSE OUTCOMES

CO1	Illustrate the basic concepts of object-oriented programming.
CO2	Design appropriate classes for the given real-world scenario.
CO3	Illustrate the concepts of **constructors and destructor.**
CO4	Use the knowledge of inheritance for developing optimized solutions
CO5	Apply the knowledge of compile-time / run-time polymorphism to solve the given problem and File operations.

XII. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/ PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3															
CO2	3		2	2												
CO3	3		2	2												
CO4		2	2	2												
CO5		2	2													

XIII. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl.No.1

Semester End Examination (SEE): Refer Annexure-1 Sl.No.1

XIV. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Name of the publisher	Edition and Year
1	The Complete Reference C++	Schildt Herbert	Tata McGraw Hill Publication	4th Edition, 2009.

VII(b): Reference Books:

1	Object Oriented programming with C++	E Balaguruaswamy	Tata McGraw Hill	5th Edition, 2008.
2	The C++ Programming Language	Bjarne Stroustrup	Special Edition,	Pearson Education, 2004.

VII(c): Web links and Video Lectures (e-Resources):

1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw

Tutorial Link:

1. https://www.w3schools.com/cpp/cpp_intro.asp
2. https://www.edx.org/course/introduction-to-c-3
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013843642506788864433 75_shared/overview

VIII: Activity Based Learning

1. Group Assignment to develop small projects and demonstrate using C++

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	OEC		
Course Title: Introduction to Java Programming					
Course Code:	**23AIO613**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: A basic understanding of programming concepts and familiarity with general computer science principles is recommended.

I. Course Objectives:

- This course aims to provide students with a solid foundation in object-oriented programming (OOP) using Java.
- By the end of the course, students will be able to understand and apply fundamental OOP features and Java syntax.
- They will gain hands-on experience in creating, debugging, and running simple Java programs, while also learning key object-oriented concepts through practical examples.
- Additionally, students will explore how to work with packages and handle exceptions in Java, enhancing their coding efficiency.
- Thecourse also emphasizes the importance of string handling in Java and its integration with object-oriented principles to solve real-world problems

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT

Theory	
Module-1:	8 Hrs

An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries. Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings

Textbook 1: Ch 2,Ch 3

RBT Levels: L1, L2, L3

Module-2:	8 Hrs

Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements.

Textbook 1: Ch 4, Ch 5

RBT Levels: L1, L2, L3

Module-3:	8 Hrs

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, This Keyword, Garbage Collection, the finalize () Method, A Stack Class. A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, understanding statistic, introducing final, Arrays Revisited. Inheritance: Inheritance, using super, creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding.

Textbook 1: Ch 6, Ch 7.1-7.9, Ch 8.1-8.5

RBT Levels: L1, L2, L3

Module-4:	8 Hrs

Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces. Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions

Textbook 1: Ch 9, Ch 10.

RBT Levels: L1, L2, L3

Module-5:	8 Hrs

Enumerations: Enumerations, Type Wrappers. String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf(), Changing the Case of Characters Within a String , Additional String Methods, String Buffer, StringBuilder.

Textbook 1: Ch 12. 1,1 2.2, Ch 15

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Develop Java programs by applying object-oriented programming principles and ensuring proper program structure.
CO2	Create Java programs that utilize packages, inheritance, and interfaces to design efficient, reusable code.
CO3	Implement error handling techniques in Java by effectively using exception handling mechanisms.
CO4	Demonstrate proficiency in string handling concepts and manipulation in Java.
CO5	Apply object-oriented programming concepts to solve real-world problems using Java effectively.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1	1	3		1										
CO2	1	1	2		1										
CO3	1	1	2												
CO4	2	1	1												
CO5	1	2	3												

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.2 Section-1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.2 Section-1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Java The Complete Reference	Herbert Schildt	7th Edition, 2007	Tata McGraw Hill,

VII(b): Reference Books:

1	Object oriented Programming with java	Rajkumar Buyya, S Thamarasiselvi, Xincheng chu,	2020	Tata McGraw Hill
2	Programming with Java A primer	E Balagurusamy	2019	Tata McGraw Hill

VII(c): Web links and Video Lectures (e-Resources):

- https://docs.oracle.com/en/java/
- https://www.tutorialspoint.com/java/index.htm
- https://www.javacodegeeks.com/
- https://www.youtube.com/playlist?list=PLS1QulWo1RIYsQ2SrpK9HgAfp21aP3bvx
- https://www.youtube.com/playlist?list=PLBlnK6fEyqRiDh-jzVg5ODR9Tx9HJ9I-B
- https://www.youtube.com/watch?v=Qgl81fPcLc8
- https://www.coursera.org/courses?query=java

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	OEC		
Course Title: Introduction to Operating Systems					
Course Code:	**23AIO614**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: A basic understanding of computer architecture and programming concepts is required.

I. Course Objectives:

- The course aims to provide a comprehensive understanding of operating systems (OS), emphasizing the need for OS and exploring the various types available.
- It will cover effective techniques for managing system resources, including processors, memory, storage, and file systems.
- Additionally, the course will introduce and demonstrate relevant APIs and commands used in the management of these key system components.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT

Theory

Module-1:	8 Hrs

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments. Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design andimplementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot.

Textbook 1: Chapter – 1 (1.1-1.12), 2 (2.2-2.11)

RBT Levels: L1, L2, L3

Module-2:	8 Hrs

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)

RBT Levels: L1, L2,L3

Module-3:	8 Hrs

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Textbook 1: Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)

RBT Levels: L1, L2, L3

Module-4:	8 Hrs

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Textbook 1: Chapter -8 (8.1-8.6), 9 (9.1-9.6)

RBT Levels: L1, L2, L3

Module-5:	8 Hrs

File System, Implementation of File System: File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Secondary Storage Structure, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix.

Textbook 1: Chapter – 10 (10.1-10.5) ,11 (11.1-11.5),12 (12.1-12.5), 14 (14.1-14.4)

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Explain the structure and functionality of an operating system.
CO2	Apply appropriate CPU scheduling algorithms and memory management techniques.
CO3	Analyze techniques for process synchronization and deadlock handling.
CO4	Explain file and secondary storage management strategies.
CO5	Describe the need for information protection mechanisms.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	1	2													
CO2	2	2													
CO3		1	2												
CO4		2													
CO5	2			1						1					

VI. Assessment Details (CIE & SEE)
General Rules: Refer Annexure-1
Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1
Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Operating System Principles 8th edition,	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne,	2015	Wiley-India

VII(b): Reference Books:

1	Operating Systems: A Concept Based Approach	D.M Dhamdhere	3rd Ed, 2013.	McGraw- Hill,

VII(c): Web links and Video Lectures (e-Resources):

- https://youtu.be/mXw9ruZaxzQ
- https://youtu.be/vBURTt97EkA
- https://www.youtube.com/watch?v=783KABtuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f 4. https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	ETC		
Course Title: UI/UX Using Flutter					
Course Code:	**23AIE641**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic knowledge of programming concepts and familiarity with mobile app development is recommended.

I. Course Objectives:

- This course aims to equip learners with the fundamental principles of user experience (UX) and user interface (UI) design, while also providing hands-on experience with the Flutter framework.
- Students will explore key UX concepts such as design thinking, user personas, and prototyping, and learn how to implement these ideas in Flutter to create visually appealing and user-friendly mobile apps.
- By the end of the course, participants will be able to design, prototype, and test high-quality, cross-platform mobile applications usingFlutter, integrating best practices for usability, performance, and design consistency across both Android and iOS platforms.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT	
Theory	
Module 1:	8 Hrs

Usability to User Experience (UX): Define usability and explore how it impacts overall user experience. Discuss the importance of usability testing in mobile app design. Emotional Impact in UX: Explain how emotions influence user behavior and decision-making in mobile apps. Flutter offers rich animations and transitions that can evoke emotions and engagement.
Business Case for UX: Discuss the importance of aligning UX goals with business objectives. Introduce Flutter's cost-effective nature for cross-platform app development, which can help businesses achieve greater ROI.
T**extbook: 1, 2**

RBT Levels: L1, L2, L3

Module-2:	8 Hrs

Design Thinking: Explore Design Thinking principles (Empathize, Define, Ideate, Prototype, Test). Discuss how Flutter facilitates rapid prototyping through Hot Reload and its fast development cycle.
User Personas: Create detailed user personas to better understand the target audience. Discuss how Flutter can cater to different personas by building adaptable UIs for various screen sizes.
T**extbook: 1, 3**

RBT Levels: L1, L2,L3

Module-3:	8 Hrs

Detailed Design and Wireframes: Discuss the transition from wireframes to detailed design. Show how to convert wireframes into Flutter code using layout widgets like GridView, ListView, Padding, and Align. Show how to implement detailed screens with Flutter's powerful widget system.
UX Goals, Metrics, and Targets: Define UX goals (e.g., reducing app load time, increasing user retention). Introduce tools like Flutter's DevTools for tracking app performance metrics (e.g., build times, frame rendering). Discuss how to set UX metrics and track success using Google Analytics integrated with Flutter.
T**extbook: 1, 4**

RBT Levels: L1, L2, L3

Module-4:	8 Hrs

Prototyping: Depth & breadth of a prototype, Fidelity of prototypes, Paper prototypes. Connections with Software Engineering: Foundations for success in SE-UX development, The challenge of connecting SE and UX. Emphasize Flutter's support for cross-functional teams and rapid iterations, highlighting its ease of integration with backend systems and API connections
T**extbook: 1, 5**

RBT Levels: L1, L2, L3

Module-5:	8 Hrs

UX Design Guidelines: Using and interpreting design guidelines, Human memory limitations, UX design guidelines & examples, Planning, Translation, Physical action, Outcomes, Assessment, Overall.
T**extbook: 1, 6**

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Explain the user experience design requirements
CO2	Explain the principles of Design Thinking and apply them to UX design within the Flutter framework
CO3	Implement UX goals related to app performance, such as load time and usability, within a Flutter app.
CO4	Apply collaborative techniques in Flutter development to ensure seamless integration of UX design with backend systems and APIs.
CO5	Explain UX design principles with case examples

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2		1										2		
CO2	2	1	3		2								1	1	1
CO3	2				2								2		1
CO4	1			2									1		1
CO5			2										1	1	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	The UX Book-Process and Guidelines for Ensuring a Quality User Experience	Rex Hartson And Pardha S. Pyla	2012.	Morgan Kaufmann, Elsevier
2	Don't Make Me Think" by Steve Krug	Steve Krug	3rd Ed, 2014	New Riders
3	Flutter for Designers" by Stoyan Stefanov	Stoyan Stefanov	1st Ed, 2020	Smashing Magazine
4	Lean UX: Applying Lean Principles to Improve User Experience	Jeff Gothelf	1st Ed, 2013	O'Reilly Media
5	Prototyping: A Practitioner's Guide by Todd Zaki Warfel	Todd Zaki Warfel	1st Ed, 2012	Morgan Kaufmann
6	Flutter Complete Reference" by Alberto Miola	Alberto Miola	1st Ed, 2020	Apress

VII(b): Reference Books:

1	Mobile First	Luke Wroblewski	1st Ed , 2011	A Book Apart

VII(c): Web links and Video Lectures (e-Resources):

https://flutter.dev/docs
https://material.io/design
https://flutter.dev/docs/development/ui/widgets

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	ETC		
Course Title: Django Framework and Applications					
Course Code:	**23AIE642**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic understanding of Python programming and web development concepts.

I. Course Objectives:

- The course aims to help students gain a comprehensive understanding of full-stack web development. Students will learn how to leverage rapid application development for designing responsive web pages and explore the integration of Models, Views, and Templates within Django.
- They will also demonstrate proficiency in state management and automating admin interfaces in Django, as well as designing and implementing Django apps with dynamic pages connected to SQL databases.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT

Theory

Module-1: MVC based Web Designing	8 Hrs

Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.
Textbook 1: Chapter 1 and Chapter 3

RBT Levels: L1, L2, L3

Module-2: Django Templates and Models	8 Hrs

Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.
Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution
Textbook 1: Chapter 4 and Chapter 5

RBT Levels: L1, L2,L3

Module-3: Django Admin Interfaces and Model Forms	8 Hrs

Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.
Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs.
Textbook 1: Chapters 6, 7 and 8

RBT Levels: L1, L2, L3

Module-4: Generic Views and Django State Persistence	8 Hrs

Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.
MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.
Textbook 1: Chapters 9, 11 and 12

RBT Levels: L1, L2, L3

Module-5: jQuery and AJAX Integration in Django	8 Hrs

Ajax Solution, Java Script, XHTML HttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django
Textbook 2: Chapters 1, 2 and 7

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Understand the workings of MVT-based full-stack web development with Django.
CO2	Design Models and Forms for the rapid development of web pages.
CO3	Analyze the role of Template Inheritance and Generic Views in developing full-stack web applications.
CO4	Apply Django framework libraries to render non-HTML content such as CSV and PDF.
CO5	Perform jQuery-based AJAX integration with Django apps to build responsive full-stack web applications.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2				1								2		
CO2	1		2												
CO3	1	2		1											
CO4	2			1									1		
CO5	2		1		2										

VI. Assessment Details (CIE & SEE)
General Rules: Refer Annexure-1
Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1
Semester End Examination (SEE): Refer Annexure-1 Sl. No.1
VII. Learning Resources
VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	The Definitive Guide to Django: Web Development Done Right	Adrian Holovaty, Jacob Kaplan Moss	Second Edition, 2009	Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers,
2	Django Java Script Integration: AJAX and jQuery	Jonathan Hayward	First Edition, 2011	Pack Publishing,
VII(b): Reference Books:				
1	Jake Kronika, Django 3 Web Development Cookbook	Aidas Bendroraitis	Fourth Edition, 2020	Packt Publishing,
2	Django for Beginners: Build websites with Python and Django	William Vincent	First Edition, 2018	Amazon Digital Services
3	Django3 by Example	Antonio Mele	3rd Edition, 2020	Pack Publishers
4	Django Design Patterns and Best Practices	Arun Ravindran	2nd Edition, 2020	Pack Publishers
5	Light weight Django, David A. Bell,	Julia Elman, Mark Lavin	1st Edition, 2014	Oreily Publications

VII(c): Web links and Video Lectures (e-Resources):

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

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	ETC		
Course Title: Scalable Data Analytics					
Course Code:	**23AIE643**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: Basic knowledge of programming, data structures, and databases is recommended.

I. Course Objectives:

- The Scalable Data Analytics course aims to equip learners with the skills to design, implement, and optimize data analytics systems capable of handling large-scale datasets. Students will explore key big data technologies like Hadoop, Spark, and NoSQL databases, and learn how to process, analyze, and visualize data efficiently.
- The course also covers cloud-based data analytics solutions, emphasizing scalability, real- time analytics, and best practices for deploying analytics systems in the cloud.
- By the end of the course, learners will be prepared to tackle complex data challenges and leverage modern tools for large-scale data processing and analysis.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

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III. COURSE CONTENT	
Theory	
Module-1: Introduction to Data Analytics and Big Data	8 Hrs

Overview of Data Analytics, Introduction to Big Data, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, and Value). Data processing vs. Data analytics., Big Data Architecture, Components: Data storage, data processing, and analytics platforms. Overview of distributed computing. Scalable Data Systems, Introduction to scalable data processing frameworks. Challenges in handling large-scale data. Data Analytics Lifecycle, Data collection, cleaning, transformation, analysis, and visualization.
TextBook-1, TextBook-2

RBT Levels: L1, L2, L3

Module-2: Scalable Data Processing with Hadoop and MapReduce	8 Hrs

Introduction to Hadoop-Hadoop ecosystem and its components (HDFS, YARN, MapReduce).
Setting up a basic Hadoop cluster., HDFS (Hadoop Distributed File System) Architecture and functioning of HDFS, Data storage, replication, and fault tolerance. MapReduce Programming Model, Introduction to MapReduce: Map and Reduce functions. Writing basic MapReduce programs, Optimizing MapReduce Jobs, Performance considerations and best practices.
Combiner, partitioner, and secondary sorting, Hadoop in Real-World Scenarios, Batch processing in big data workflows. Use cases: Log analysis, data transformation, and ETL processes.
TextBook-2, TextBook-3

RBT Levels: L1, L2, L3

Module-3: Advanced Scalable Data Processing with Spark	8 Hrs

Introduction to Apache Spark, Spark Programming Basics, Optimizing Spark Jobs, Spark Streaming Machine Learning with Spark MLlib, Introduction to Spark MLlib for scalable machine learning. Building and evaluating machine learning models on Spark.
TextBook-4, TextBook-5

RBT Levels: L1, L2, L3

Module-4: Scalable Data Storage and NoSQL Databases	8 Hrs

Introduction to NoSQL Databases: Types of NoSQL databases: Key-value stores, Document stores, Column-family stores, and Graph databases, Use cases and advantages of NoSQL over traditional SQL databases, HBase: A Scalable NoSQL Database, HBase architecture and integration with Hadoop, Writing and reading data with HBase, Cassandra: Scalable Distributed Database Overview of Apache Cassandra architecture, Data modeling and querying in Cassandra, MongoDB: A Document-Oriented Database MongoDB architecture and features, Using MongoDB for scalable data storage and querying, Comparing NoSQL Databases Performance and scalability trade-offs between HBase, Cassandra, and MongoDB.
TextBook-6, TextBook-7

RBT Levels: L1, L2, L3

Module-5: Data Visualization and Scalable Analytics in the Cloud	8 Hrs

Data Visualization Fundamentals, Importance of data visualization in analytics, Introduction to tools for visualizing large-scale data, Using Tableau for Big Data Visualization, Integrating Tableau with Hadoop and Spark, Creating visual dashboards and reports, Introduction to Cloud Computing for Data Analytics Overview of cloud services for big data analytics: AWS, Azure, and Google Cloud, Introduction to managed services for big data (Amazon EMR, Azure HDInsight, Google Dataproc). Serverless Data Analytics in the Cloud, Serverless architectures for scalable data processing, Using AWS Lambda and Google Cloud Functions for event-driven analytics. Real-World Use Cases for Scalable Analytics in the Cloud, Use cases: Real-time analytics, fraud detection, predictive analytics, Best practices for scaling analytics pipelines in the cloud.
TextBook-8, TextBook-9

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Understand the principles of scalable data analytics and big data technologies.
CO2	Design and implement scalable data processing workflows using Hadoop and MapReduce
CO3	Develop applications for big data analysis using Apache Spark and optimize performance.
CO4	Work with NoSQL databases like HBase, Cassandra, and MongoDB for scalable data storage and querying.

CO5	Utilize cloud services for data analytics and visualization, and implement serverless architectures for scalability.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2												1		
CO2	2	1	2										2	1	
CO3	1	2	2		2								2		
CO4	2			2	1								1	1	
CO5	2	1		1									1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Data Science for Business	Foster Provost & Tom Fawcett	1st Edition, 2013	O'Reilly Media
2	The Definitive Guide	Tom White	4th Edition, 2015	O'Reilly Media
3	Hadoop in Action	Chuck Lam	1st Edition, 2010	Manning Publications
4	Learning Spark: Lightning-Fast Big Data Analysis	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia	1st Edition, 2015	O'Reilly Media
5	Spark: The Definitive Guide	Bill Chambers, Matei Zaharia	1st Edition, 2018	O'Reilly Media
6	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence	Pramod J. Sadalage, Martin Fowler	1st Edition, 2012	Addison-Wesley

VII(b): Reference Books:

7	Cassandra: The Definitive Guide	Jeff Carpenter, Eben Hewitt	2nd, Edition, 2016	O'Reilly Media
8	Big Data and Cloud Computing: Making Data-Driven Decisions	Seema Acharya, Subhashini Tripathi	1st Edition, 2016	Wiley
9	Cloud Analytics with Google Cloud Platform	Hannes L. M. Hönle	1st Edition, 2020	O'Reilly Media

VII(c): Web links and Video Lectures (e-Resources):

- https://hadoop.apache.org/docs/
- https://spark.apache.org/docs/latest/
- https://university.mongodb.com/
- http://cassandra.apache.org/doc/latest/
- https://cloud.google.com/solutions/big-data
- https://aws.amazon.com/big-data/
- https://www.khanacademy.org/computing/computer-programming
- https://www.youtube.com/watch?v=0Yo_Js7rA6k

- https://www.youtube.com/watch?v=_C8kWso4ne4
- https://university.mongodb.com/
- https://www.youtube.com/watch?v=51l9NJctGH0
- https://www.edx.org/course/data-science-and-big-data-analytics-emc
- https://www.youtube.com/watch?v=ub8yV8DZmb8
- https://www.youtube.com/watch?v=9kZfxJZa5pI
- https://www.youtube.com/watch?v=UsBzx_oHzpQ

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	ETC		
Course Title: Network Security					
Course Code:	**23AIE644**			**Credits:**	3
Teaching Hours/Week (L:T:P:O) (O – Other pedagogies, mention @)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre-requisite: A basic understanding of computer networks and cybersecurity principles is required.

I. Course Objectives:

- The course aims to provide a comprehensive understanding of network security services and mechanisms.
- It covers essential topics such as Transport Layer Security (TLS) and Secure Socket Layer (SSL), focusing on how they ensure secure communication over networks.
- Students will also explore security concerns in Internet Protocol security and how to protect against various vulnerabilities.
- The course delves into the detection of intruders, intrusion detection systems, and the impact of malicious software on network security.
- Additionally, it discusses the role of firewalls in network protection, including their characteristics, configuration, and biasing techniques to enhance overall network security.

II. Teaching-Learning Process (General Instructions):

The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:

1. **Diverse Teaching Methods**: Instead of relying solely on traditional lecture methods, can explore alternative and effective teaching approaches. These might include interactive discussions, hands-on activities, or multimedia presentations.
2. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
3. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
4. **Higher Order Thinking (HOT) Questions**: Pose at least three thought-provoking questions during class. These questions stimulate critical thinking and encourage students to analyze and evaluate information.
5. **Problem-Based Learning (PBL):** Implement PBL, which nurtures analytical skills. PBL goes beyond rote memorization by challenging students to design solutions, evaluate evidence, and think critically.
6. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
7. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
8. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension and retention.

☐ Chalk & Talk ☐ Stud. Assignment ☐ Web Resources ☐ LCD/Smart Boards ☐ Stud. Seminars

III. COURSE CONTENT	
Theory	
Module-1:	8 Hrs

Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks.
TextBook-2: Chapter 1

RBT Levels: L1, L2, L3

Module-2:	8 Hrs

Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)
TextBook-1: Chapter15

RBT Levels: L1, L2, L3

Module-3:	8 Hrs

IP Security: Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange.
TextBook-1: Chapter 19

RBT Levels: L1, L2, L3

Module-4:	8 Hrs

Intruders, Intrusion Detection. MALICIOUS SOFTWARE: Viruses and Related Threats, Virus Counter measures,
TextBook-1: Chapter 20, Chapter 21

RBT Levels: L1, L2, L3

Module-5:	8 Hrs

Firewalls: The Need for firewalls, Firewall Characteristics, Types of Firewalls, Firewall Biasing, Firewall location and configuration
TextBook-1: Chapter22

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES: At the end of this course, students will be able to

CO1	Identify network security services and mechanisms
CO2	Understand the concepts of Transport Layer Security and Secure Socket Layer.
CO3	Illustrate operations and architecture in Internet Protocol security.
CO4	Explain the intrusion detection and malicious software in networks.
CO5	Develop and implement the configuration for firewall applications.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2												1		
CO2	2	1	2										2		
CO3	2												1		
CO4	2			1									1		1
CO5	2	1	2										1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure-1

Continuous Internal Evaluation (CIE): Refer Annexure-1 Sl. No.1

Semester End Examination (SEE): Refer Annexure-1 Sl. No.1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Cryptography and Network Security Principles and Practice	William Stallings	5th Edition, 2014 ISBN: 978-81-317-6166-3.	Pearson Education
2	Cryptography and Network Security	Atul Kahate	2003	TMH

VII(b): Reference Books:

1	Cryptography and Network Security	Behrouz A, Forouzan	2007	TMH

VII(c): Web links and Video Lectures (e-Resources):

- **https://chatgpt.com/#:~:text=OWASP%20(Open%20Web%20Application%20Security%20Project)**
- **https://www.cybrary.it/**
- **https://www.sans.org/**
- **https://www.youtube.com/playlist?list=PLT0JZFlYP7rcSMaF5tdOYlxs_HpQZT21q**
- **https://chatgpt.com/#:~:text=Network%20Security%20Concepts%20by%20IIT%20Kharagpur%20(NPTEL)**
- **https://www.youtube.com/watch?v=8ZgV1L_4cok**
- **https://www.youtube.com/playlist?list=PLQ6qAtF5s2RczWz5lgqlzELOeIEK53XX8**

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Assignments, Quizzes and Seminar.

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Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	AEC		
Course Title: Research Methodology & IPR					
Course Code:	**23RMAE61**		**Credits:**		03
Teaching Hours/Week (L:T:P:O)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To Understand the knowledge on basics of research and its types.
- To Learn the concept of Literature Review, Technical Reading, Attributions and Citations.
- To learn Ethics in Engineering Research.
- To Discuss the concepts of Intellectual Property Rights in engineering.

II. Teaching-Learning Process :

- Chalk and talk method
- Power point presentation / keynotes
- Videos

III. COURSE CONTENT

III(a). Theory PART

Module-1: Introduction — 08Hrs

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem.

Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Textbook 1 : Chapter1 : sections: 1.1,1.2,1.3,1.4
Textbook 1 : Chapter5 : sections: 5.1,5.2,5.3

Self Learning : Case Studies

RBT Levels: L2

Module-2: Literature Review and Technical Reading — 08Hrs

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

Textbook1: Chapter2: sections: 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10
Textbook1: Chapter3: sections: 3.1,3.2,3.3,3.4

Self Learning : Case Studies

RBT Levels: L2

Module-3: Introduction To Intellectual Property	08Hrs

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting.

Process of Patenting. Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition.

Textbook2: Chapter1: sections:1.1,1.2,1.3,1.4,1.6
Textbook2: Chapter2: sections:2.1 (2.1.1 to 2.1.9)

Self Learning : Case Studies

RBT Levels: L2

Module-4: Copyrights and Related Rights	08 Hrs

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases.

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Textbook2: Chapter2: sections: 2.2 (except 2.2.6)
Textbook2: Chapter2: sections:2.3 (2.3.1 to 2.3.10, 2.3.14)

Learning : Case Studies

RBT Levels: L2

Module-5: Industrial Designs	08Hrs

Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India.

Textbook2: Chapter2: Sections : 2.4, 2.5 (2.5.1 – 2.5.13)

Self Learning : Case Studies

RBT Levels:L2

IV. COURSE OUTCOMES

CO1	Understand the importance of engineering research and its ethics.
CO2	Interpret the fundaments of Literature Review and Technical Reading.
CO3	Outline the fundamentals of patens laws and drafting procedure.
CO4	Illustrate the copyright laws and basic principles of design rights.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2							2		1		2				
CO2	2							3		3		2				
CO3				2				3	2	2		3				
CO4								3	2	2		3				

VI. Assessment Details (CIE & SEE)

General Rules: Refer to – Academic regulations

Continuous Internal Evaluation (CIE):
Refer to Annexure, SL #5
Rubrics: Refer to Annexure, SL #5

Semester End Examination (SEE):
Refer to - Annexure, SL #5
Rubrics: Refer to - Annexure, SL #5

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher

1	Engineering Research Methodology	Dipankar Deb, Rajeeb Dey, Valentina E. Balas	ISSN 1868- 4394 ISSN 1868-4408 (electronic)	Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13-2947-0 (eBook),
2	Intellectual Property A Primer for Academia	Prof. Rupinder Tewari Ms. Mamta Bhardwaj	2021	Publication Bureau, Panjab University Chandigarh-160014, India
VII(b): Reference Books:				
1	Research Methods for Engineers	David V. Thiel	978-1-107-03488-4	Cambridge University Press
2	Intellectual Property Rights	N.K.Acharya	ISBN: 978-93-81849-30-9	Asia Law House 6th Edition
VII(c): Web links and Video Lectures (e-Resources):				
https://www.youtube.com/watch?v=5fvpsqPWZac http://kcl.digimat.in/nptel/courses/video/109106137/L68.html http://kcl.digimat.in/nptel/courses/video/109106137/L72.html http://acl.digimat.in/nptel/courses/video/109106137/L04.html				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Quizzes, Assignments, Seminars				

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Department of Artificial Intelligence and Machine Learning

Semester:	VI	**Course Type:**	HSMC		
Course Title:	**Social Connect & responsibility**				
Course Code:	**23SCRH08**	**Credits:**			01
Teaching Hours/Week (L: T: P: O)		1:0:0:0	**Total Hours:**		15
CIE Marks:	50		**Total Marks:**		50

I. Course Objectives:

- This course aims to familiarize students with the dynamics of society and importance of conscious participation in the formation of an ideal society
- The course enables students to critically analyze the social processes of globalization, modernization and social change, and its impact on the socio-cultural system.
- The course aims to develop socially responsible engineers by engaging them in real-world social issues, analyzing their impact, proposing innovative solutions, and effectively documenting their findings.
- The course enables students to create a responsible connection with the society.

II. Teaching-Learning Process (General Instructions):

This course is designed to provide students with hands-on learning experiences that foster social awareness, critical thinking, and problem-solving skills. Teachers play a crucial role in guiding students through real-world issues and encouraging innovative, ethical solutions.

1. Foster an Experiential Learning Approach
   - Encourage field visits, case studies, and real-world problem analysis rather than relying solely on theoretical lectures.
   - Use problem-based learning (PBL) where students actively engage with a community issue and work towards solving it.
2. Facilitate Active Student Engagement
   - Conduct brainstorming sessions to help students identify and understand societal problems.
   - Promote group discussions and debates on contemporary social issues.
3. Encourage Innovative & Feasible Solutions
   - Help students explore technology-driven solutions using engineering principles.
   - Promote a multi-disciplinary approach, integrating environmental, social, and economic aspects.
4. Promote Community Interaction & Implementation
   - Guide students to collaborate with NGOs, local communities, or government agencies.
   - Ensure that students test their solutions in real-world settings and collect feedback.
   - Emphasize the importance of ethical considerations in community engagement.
5. Train Students in Documentation & Reporting
   - Teach students how to prepare structured reports on their findings, solutions, and implementation outcomes.
   - Encourage presentations, digital storytelling, and video documentation for effective communication.
   - Provide constructive feedback on student projects and ensure continuous improvement.

III. COURSE CONTENT

Module-1:Introduction to Social Connect Responsibility — 03Hrs

1. Identify the factors comprising the socio-cultural system and its impact on society
2. The concept of inter-relatedness of society and culture, socio-cultural dimensions, factors contributing to socio-cultural evolution.
3. Identifying problems in areas such as education, healthcare, environment, and infrastructure.

Module-2: Understanding Social Issues — 03 Hrs

1. Understanding societal challenges in local and global contexts.
2. Role of engineers in addressing these issues.
3. Conducting preliminary field surveys and interviews

Module-3: Analyzing the Social Problem — 03 Hrs

1. Understanding the economic, environmental, and societal impact of the problem
2. Ethical and moral considerations in problem-solving by Interaction with stakeholders (community members, NGOs, government bodies)
3. Root cause analysis using tools like SWOT, Fishbone Diagram, and Case Studies.

Module-4: Proposing Engineering Solutions — 03 Hrs

1. Application of engineering knowledge to develop feasible solutions.
2. Use of technology for social good (IoT, AI, Renewable Energy, Smart Systems, etc.).
3. Sustainable and cost-effective approaches.
4. Feasibility analysis and implementation strategies.

Module-5: Documentation & Reporting — 03 Hrs

1. Preparing a structured report with problem identification, analysis, proposed solutions, and implementation insights.
2. Creating presentations, videos, and other forms of project documentation.
3. Reflecting on personal learning and the social impact of the project.
4. Submission of a final report and group presentation.

IV.COURSE OUTCOMES

CO1	Students will be able to recognize and define real-world social issues, assessing their relevance and impact on communities.
CO2	Students will develop analytical skills to investigate the root causes of social problems and evaluate their economic, environmental, and ethical implications.
CO3	Students will apply engineering principles and innovative thinking to propose feasible, sustainable, and technology-driven solutions for identified social issues.
CO4	Students gain from stakeholder's interaction and develop presentation skills.

V.CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12
CO1			1			2	1	1	1			1
CO2			1			1	2	1	1			1
CO3			1			2	2	1	1			1
CO4			1			2	1	1	1			1

VI. Formative Assessment Details (CIE)

Continuous Internal Evaluation (CIE)& Rubrics: ***Refer to Annexure section -8***

VII. Learning Resources

VII (a). Reference Books :

1. C. N. Shankar Rao (2006) Sociology of Indian Society, 2nd, S. Chand publication
2. Nandan Nilekani, Imagining India: The Idea of a Renewed Nation, Penguin Books, 2009.
3. Gurcharan Das, India Unbound: From Independence to the Global Information Age, Anchor Books, 2002.
4. Raghuram G. Rajan, I Do What I Do, Harper Business, 2017.

VIII. Activity Based Learning

1. **Community Survey:** Students visit local communities (rural/urban) to identify real social issues (sanitation, education, healthcare, infrastructure)
2. **Collaboration with NGOs & CSR Units:** Partner with organizations working on social impact projects.
3. **Sustainability Planning:** Students draft plans for scaling up their solutions in a sustainable manner.
4. **Video Documentation:** Create short films showcasing their social project progress and community feedback.

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ANNEXURE

CIE & SEE evaluation for Autonomous Scheme 2023 – UG

Note: Revised as per approvals of 4th Academic Council Meeting held on 05/02/2025

S. #	Course Type /Credits	Continuous Internal Evaluation (CIE)																					Semester End Examination (SEE)									Min. pass % (CIE + SEE)
		Total CIE marks	Min. Eligty.	I. Theory Component									II. Practical Component									Total CIE marks	Dur. In hrs.	Theory			Practical			Total SEE marks	
						A. Unit test			B. Formative Assessments			Tot. Theory marks (I)			C. Weekly Evaluation		D. Internal Test			E. Prj	Tot. marks (II)				Max. conducted marks	Max. considered marks	min. pass %	Max. conducted marks	Max. considered marks	min. pass %		
				Marks	Min. Eligty.	Nos.	Marks / Each	Tot.	Nos.	Marks / Each	Tot.		Marks	Min. Eligty.	Each week	Tot. marks	Nos.	Marks / Each	Total marks	Marks												
1	BSC/ESC/PCC/ETC /PEC/OEC (3 or 4 Credit courses)	50	40%	50	40%	2	50	50 (avg. of 2)	2	50	50 (avg. of 2)	50 (avg. of A & B)	--	--	--	--	--	--	--	--	--	50 (I)	03	100	50	35%	--	--	--	50	40%
2	IBSC/IESC/IPCC/ ETC (4 Credit courses)	50	40%	50	40%	2	50	50 (avg. of 2)	2	50	50 (avg. of 2)	50 (avg. of A & B)	50	40%	50	50 (Avg. of all)	1	50	50	50	50 (Avg. of C & [D or E])	50 (Avg. of I & II)	03	100	50	35%	--	--	--	50	40%
3	IESC - CAED (4 credit course)	50	40%	--	--	--	--		--	--		--	50	40%	50	50 (Avg. of all)	1	50	50	--	50 (Avg. of C & D)	50	03	--	--	--	100	50	35%	50	40%
4	PCCL (1 Credit courses)	50	40%	--	--	--	--		--	--		--	50	40%	50	50 (Avg. of all)	1	50	50	50	50 (Avg. of C & [D or E])	50 (II)	03	--	--	--	100	50	35%	50	40%
5	AEC- IDT, Skill Development courses (1 credit course)	50	40%	50	40%	1	50		1	50		50 (Avg. of 2)	--	--	--	--	--	--	--	--	--	50 (I)	02	50	50	35%	--	--	--	50	40%
6	HSMC- CIP, Env studies, SFH, UHV (1 credit course)	50	40%	50	40%	1	50		1	50		50 (Avg. of 2)	--	--	--	--	--	--	--	--	--	50 (I)	02	50	50	35%	--	--	--	50	40%
7	HSMC - English, Kannada (No credits)	50	40%	50	40%	1	50		1	50		50 (Avg. of 2)	--	--	--	--	--	--	--	--	--	50 (I)	--	--	--	--	--	--	--	--	40%
8	NCMC - Personality Development courses, PE, Yoga, NCC, NSS, IKS (No credits)	50	40%	50	40%	--	--		1	50		50	--	--	--	--	--	--	--	--	--	50 (I)	--	--	--	--	--	--	--	--	40%

 # Formative (Successive) Assessments: Assignments/quiz/ seminars/field survey and report presentation/course project/group discussions/etc. based on the faculty & dept. planning. **# Practical Conduction:** The conduction of each experiment/program per week should evaluate for 50 Marks and average of all shall be taken. **# In case of Integrated course,** minimum eligibility shall be attained as prescribed in both the theory and practical components.
 # Self Learning Courses (SLC) Courses, Internship, Mini project & Major Project: Rubrics & Methodology shall be defined seperately

Academic Dean 10/2/25

Principal 10.2.2025

Academic Director 10/2/25

ANNEXURE

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CIE and SEE guidelines for Autonomous Scheme 2023 –ಆ೬

Note: Revised as per approvals of 4th Academic Council Meeting held on 05/02/2025

Continuous Internal Evaluation (CIE)	Semester End Examination (SEE)	Final Passing requirement
1. BSC/ESC/PCC/ ETC/PEC/OEC – Theory Course (03 & 04 Credit courses)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and it will have only 01 component (I): **I. Theory component:** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative Assessments (FA). **A. Internal Assessment Test:** i) There are 02 tests each of 50 marks conducted during 8th week & 15th week, respectively. ii) The question paper will have four questions (max of 3 sub questions) from the notified syllabus. Each question is set for 25 marks. iii) The student must answer 2 full questions (one from 1st & 2nd questions and another from 3rd & 4th question).	**Semester-End Examination:** The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). Duration of 03 hours and total marks of 100. i) The question paper will have ten questions. Each question is set for 20 marks. ii) There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. iii) The students have to answer 5 full questions, selecting one full question from each module. iv) Marks scored shall be proportionally reduced to 50 marks.	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

Academic Dean 10/2/25

Principal 10.2.2025

Academic Director 10/2/25

iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcomes defined for the course. **B. Formative assessments:** i) 02 formative assessments each of 50 marks shall be conducted by the course coordinator based on the dept. planning during random times. ii) One formative assessment shall be completed before 5th week and second shall be completed before 12th week. iii) The syllabus content for the formative assessment shall be defined by the course coordinator. iv) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. v) The assignment QP or Quiz QP shall indicate marks of each question and the relevant COs & RBT levels. vi) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean. **The final CIE marks will be 50:** CIE = Avg. {Avg. of two tests + Avg. of two FA} **The documents of all the assessments shall be maintained meticulously.**		
2. IBSC/IESC/IPCC– Integrated with Theory & Practical (04 credit courses), ETC (if offered as integrated course)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). Minimum eligibility of 40% marks shall be attained separately in both the theory component and practical component. CIE will be conducted by the department and it will have 02 component: I. Theory Component. II. Practical Component. **I. Theory Component:** Theory component will consist of A. Internal Assessment Test (IAT). B. Formative assessments (FA).	The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). **Semester-End Examination:** Only theory SEE for duration of 03 hours and total marks of 100. i) The question paper will have ten questions. Each question is set for 20 marks. ii) There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

A. Internal Assessment Test: i) There are 02 tests each of 50 marks conducted during 8th week & 15th week, respectively. ii) The question paper will have four questions (max of 3 sub questions) from the notified syllabus. Each question is set for 25 marks. iii) It is suggested to include questions on laboratory content in the Internal Assessment test Question papers. iv) The student must answer 2 full questions (one from 1st & 2nd questions and another from 3rd & 4th question). v) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course. **B. Formative assessments:** i) 02 formative assessments each of 50 marks shall be conducted by the course coordinator based on the dept. planning during random times. ii) One formative assessment shall be completed before 5th week and second shall be completed before 12th week. iii) The syllabus content for the formative assessment shall be defined by the course coordinator. iv) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. v) The assignment QP or Quiz QP shall indicate marks of each question and the relevant COs & RBT levels. vi) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean. **II. Practical Component:** **C.** Conduction of each experiment/program should be evaluated for 50 marks and average of all the experiments/programs shall be taken. (rubrics will be published by the concerned committee) **D.** One laboratory Internal Assessment test will be conducted during the 14th week for 50 marks. (rubrics will be published by the concerned committee) **E.** If the course project / mini project is involved in the laboratory component. **The evaluation shall be completed by 14th week of the semester.** The rubrics required for the evaluation of the project shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean.	iii) The laboratory content must be included in framing the theory question papers. iv) The students have to answer 5 full questions, selecting one full question from each module. v) Marks scored shall be proportionally reduced to 50 marks. **No Practical SEE for Integrated Course.** **Note:** CAED Course shall not be considered here. It shall be considered as in sl. No. 3 in the next row	

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Note:

i) If component 'E' is involved in the course, either component 'D' or 'E' along with component 'C' shall be considered for average of item II.

ii) Otherwise, components 'C' & 'D' shall be considered for average of item II.

The final CIE marks will be 50:

CIE= Avg. {**I** [Avg. of two tests + Avg. of two FA] + **II** [Avg. of (C & (D or E))]}

The documents of all the assessments shall be maintained meticulously.

Note: CAED Course shall not be considered here, it shall be considered as in sl. no. 3 in the next row.

3. IESC: CAED Course (4 credits)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).

i) CIE shall be conducted for max. marks of 100 and shall be scaled down to 50 marks

ii) CIE component should comprise of both Manual and computer drafting i.e. 50% manual and 50% computer drafting out of total 100 marks

iii) CIE component should comprise of Continuous evaluation of drawing work of students as and when the modules are covered based on below detailed weightage.

Module	Module Max. Marks	Evaluation Weightage in marks	
		Computer display and print out	Manual Sketching
Module 1	20	10	10
Module 2	20	10	10
Module 3	20	10	10
Module 4	20	10	10
Module 5	20	10	10
TOTAL	**100**	**50**	**50**

The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks).

Semester-End Examination:

SEE for duration of 03 hours and total marks of 100.

i) SEE shall be conducted and evaluated for maximum marks of 100 and shall be scaled down to 50 marks.

ii) Question paper shall be made available for each batch as per schedule.

iii) Evaluation shall be carried jointly by both the internal & external examiners.

iv) Scheme of Evaluation: To be defined by both the examiners jointly.

v) Maximum 3 questions shall be set as per the following pattern.

The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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iv) At least one Test covering all the modules is to be conducted for 100 marks during 14th week and the same is to be scaled down to **25 Marks.**

v) Assignments = **10 Marks from each module. (50 marks scaled down to 25 Marks)**

vi) The final CIE 50 marks = Test (25 marks) + Assignment (25 marks).

From Module	Marks Allotted
Module 01 (Choice between Lines or Planes)	30
Module 02 (Compulsory question)	40
Module 03 or Module 04 or Module 05	30
TOTAL	**100**

Q. No.	Manual Sketching	Computer display and print out	TOTAL MARKS
1	15	15	30
2	20	20	40
3	15	15	30
TOT.	**50**	**50**	**100**

4. PCCL: Laboratory course (01 credit course)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).

CIE will be conducted by the department and it will have only 01 component:

I. Theory Component. (Not required for Laboratory course)

II. Practical Component.

II. Practical Component:

C. Conduction of each experiment/program should be evaluated for 50 marks and average of all the experiments/program shall be taken (rubrics will be published by the concerned committee).

D. One laboratory Internal Assessment test will be conducted for 50 marks (rubrics will be published by the concerned committee).

E. If the course project / mini project is involved in the laboratory component. **The evaluation shall be completed by 14th week of the semester.** The rubrics required for the evaluation of the project shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean.

The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks).

Semester-End Examination:

Only laboratory SEE will be conducted jointly by the internal examiner and external examiner appointed by COE as per the scheduled timetable for duration of 03 hours.

i) The examination shall be conducted for 100 marks and shall be reduced to 50 marks proportionately.

ii) All laboratory experiments/programs are to be included for practical examination.

iii) Breakup of marks (Rubrics) and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners (OR) based on the course

The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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Note: **i)** If component 'E' is involved in the course either component 'D' or 'E' along with component 'C' shall be considered for average of item II. **ii)** Otherwise, components 'C' & 'D' shall be considered for average of item II. **The final CIE marks will be 50** = Avg. of (C & [D or E]) **The documents of all the assessments shall be maintained meticulously.**	requirement evaluation rubrics shall be decided jointly by examiners. iv) Students can pick one question (experiment/program) from the questions lot prepared by the internal /external examiners jointly. v) Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. vi) General rubrics suggested for SEE: writeup-20%, Conduction procedure and results-60%, Viva-voce 20% of maximum marks. vii) Change of experiment is allowed only once and shall be assessed only for 85% of the maximum marks.	

5. AEC: Ability Enhancement Courses (01 credit courses)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative Assessments (FA). **A. Internal Assessment Test:** i) 01 test of 50 marks conducted during 15th week. ii) The question paper will be of Multiple-Choice Questions (MCQ). iii) The student must answer all questions. iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.	The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). **Semester-End Examination:** Theory SEE will be conducted by COE as per the scheduled timetable for duration of 02 hours and total marks of 50. i) Multiple choice Question paper. ii) The students have to answer all questions.	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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B. Formative assessments: i) 01 formative assessment of 50 marks shall be conducted by the Course coordinator based on the dept. planning during 12th week. ii) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50:** CIE = Avg. of 02 events (01 IAT and 01 FA). **The documents of all the assessments shall be maintained meticulously.**		

6. HSMC: (01 credit course)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative Assessments (FA). **A. Internal Assessment Test:** i) 01 test of 50 marks conducted during 15th week. ii) The question paper will be of Multiple-Choice Questions (MCQ). iii) The student must answer all questions. iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** i) 01 formative assessment of 50 marks shall be conducted by the faculty based on the dept. planning during 12th week. ii) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc.	The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). **Semester-End Examination:** Theory SEE will be conducted by COE as per the scheduled timetable for duration of 02 hours and total marks of 50. i) Multiple choice Question paper. ii) The students have to answer all questions	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50:** CIE = Avg. of 02 events (01 IAT and 01 FA). **The documents of all the assessments shall be maintained meticulously.**		
7. HSMC: (0 credit courses)		
The weightage is only for Continuous Internal Evaluation (CIE).		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative assessments (FA). **A. Internal Assessment Test:** i) 01 test of 50 marks conducted during 15th week. ii) The QP will be of Multiple-Choice Questions (MCQ). iii) The student must answer all questions. iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** i) 01 formative assessment of 50 marks shall be conducted by the faculty based on the dept. planning during 12th week. ii) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50:** CIE = Avg. of 02 events (01 IAT and 01 FA). **The documents of all the assessments shall be maintained meticulously.**	No Semester End Examination.	The student is declared as a pass in the course if he/she secures a minimum of 40% (20 marks out of 50) in the CIE.

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8. NCMC: (0 credit course)		
The weightage is only for Continuous Internal Evaluation (CIE).		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of only 01 assessment A. Internal Assessment Test (not required for NCMC course). B. Formative Assessment (FA). **B. Formative assessments:** i) 01 formative assessment of 50 marks shall be conducted by the faculty based on the dept. planning during random times during 12th week. ii) The formative assessments include Quiz/Assignments/seminars/case study/field survey/ report presentation/course project/etc. iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50.** **The documents of all the assessments shall be maintained meticulously.**	No Semester End Examination.	The student is declared as a pass in the course if he/she secures a minimum of 40% (20 marks out of 50) in the CIE.

Academic Dean
Dr. Babu N V

Principal
Dr. K V Mahendra Prashanth

Academic Director
Dr. Puttaraju

Academic Dean

Principal 10.2.2025

Academic Director

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Recognized by UGC, New Delhi with 2(f) & 12 (B)

Program Outcomes (POs)- Graduate Attributes

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

|| Jai Shree Gurudev ||
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ATAL Ranking:
Band Performer

Band of 151 to 300 in
Innovation Category