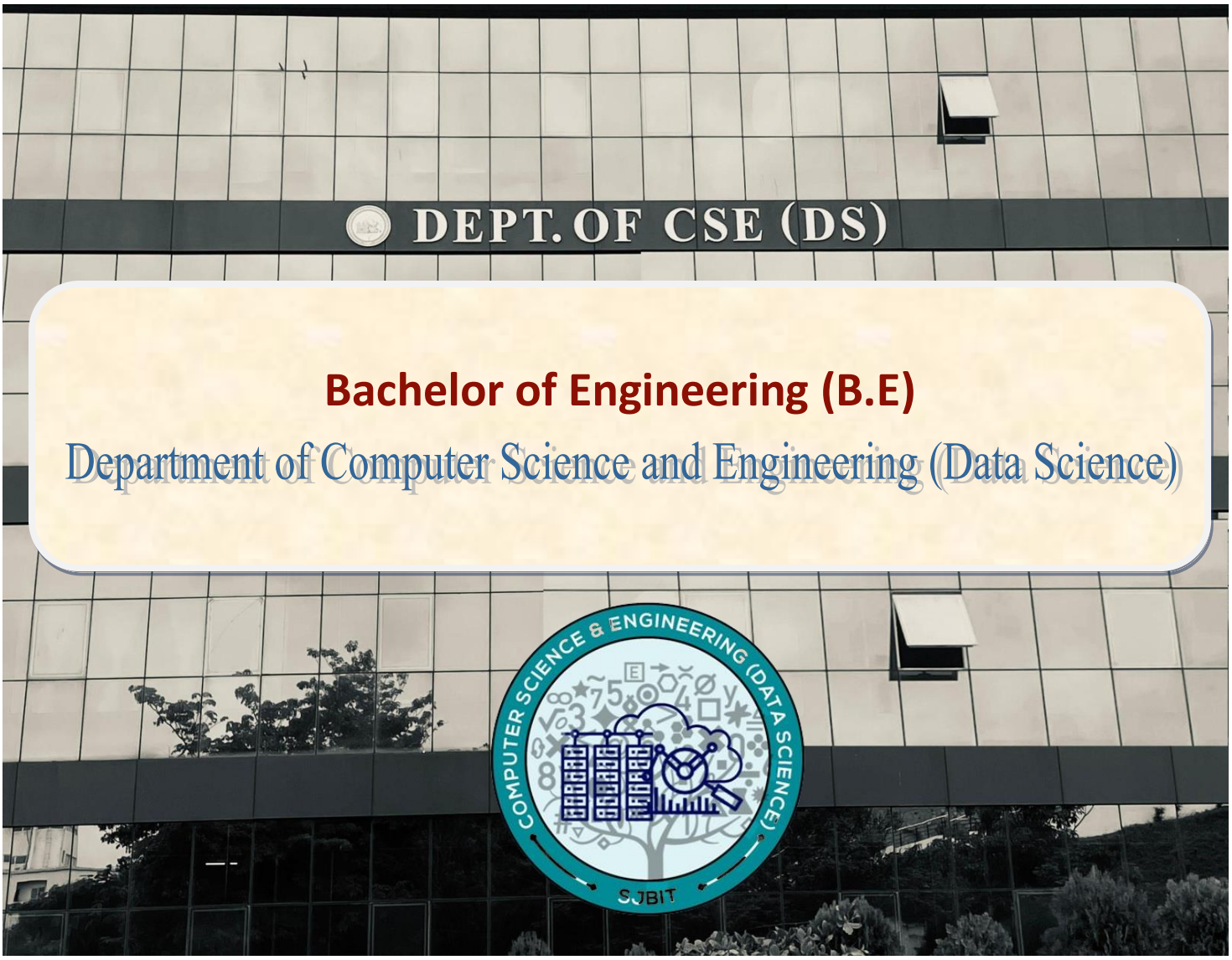
|| Jai Sri Gurudev ||

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



Bachelor of Engineering (B.E)

Department of Computer Science and Engineering (Data Science)

Autonomous

Scheme and Syllabus

Second Year

III & IV Semester

2023 Scheme

SERVICE TO MANKIND IS SERVICE TO GOD

His Divine Soul 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.

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SJB Institute of Technology
BGS Health and Education City, Dr. Vishnuvardhana Road, Kengeri, Bengaluru-560060
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Department of Computer Science and Engineering (Data Science)

Table of Contents

Vision

To enrich the next generation of young data practitioners, accomplish academic excellence and bring forward the Data Scientists.

Mission

M1: Grooming the students equipping with advanced technical knowledge to be industry-ready and globally competent.

M2: Facilitate quality data science education, enable students to become skilled professionals to solve real-time problems through industry collaboration.

M3: Encourage ethical value based transformation to serve the society with responsibility emphasizing on innovation and research methods

Program Educational Objectives

PEO1. Apply the structured statistical and mathematical methodology to process massive amounts of data to detect underlying patterns to make predictions under realistic constraints and to visualize the data.

PEO2. Promote design, research, product implementation and services in the field of Data Science by using modern tools

Program Specific Outcomes

PSO1: Apply the skills in the multi-disciplinary area of Data Science.

PSO2: Demonstrate Engineering Practice learnt to solve real-time problems in various domains.

2023 Scheme – UG

Syllabus for 3rd & 4th 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	03/09/2024	First release
Version 2	10/02/2025	Changed CIE and SEE Guidelines

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 2nd Year

Dept. of Computer Science and Engineering (Data Science)

SCHEME: 2023 **SEM: III** **Revision Date: 8/26/2024**

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	IBSC	3	23CDI301	Discrete Mathematics and Graph Theory	Maths	Maths	4	2	2	2	@	50	03	50	-	100
2	PCC	1	23CDT302	Data Structure and its Apllications	CSE(DS)	CSE(DS)	3	3	0	0		50	03	50	-	100
3	IPCC	1	23CDI303	Digital Design and Computer Orgnaization	CSE(DS)	CSE(DS)	4	3	0	2		50	03	50	-	100
4	IPCC	2	23CDI304	Operating System	CSE(DS)	CSE(DS)	4	3	0	2		50	03	50	-	100
5	PCCL	1	23CDL305	Data Structure Lab	CSE(DS)	CSE(DS)	1	0	0	2		50	03	-	50	100
6	ETC	1	23CDE31y	Emerging Technology Course - 1	CSE(DS)	CSE(DS)	3	3	0	0	@	50	03	50	-	100
7	AEC	3	23CDAE31	Programming with Java	I.E.	I.E.	1	1	0	0	3	50	02	50	-	100
8	NCMC	3	23PDSN03	Skilful Futures: Empowering Aptitutde and Softskills.	I.E.	I.E.	**PP/NP**	0	0	0	2	50	-	-	-	50
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**	**15**	**2**	**8**	**7**	**450**		**300**	**50**	**800**

BSC: Basic Science Course; PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; AEC: Ability Enhancement Course; {I.E.-Industry Experts};
{@ - Compulsory one activity}.
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).

NCMC (Non Credit Mandatory Course): The following guidelines are applicable for the course type series-4 as mentioned above.

1) All students must register for any one of the course with the department during the first week of the III semester.
2) Once registered for a course in the III semester, the student shall continue and complete the same course in the remaining semesters. No provision for changing the courses after registration.
3) Activities shall be carried out by the students between III semester to VI semester (for 4 semesters).
4) The activities shall be organized, executed and monitored by the concerned department as mentioned above in coordination with the department level course coordinators. The same shall be reflected in the calendar of events of the above concerned departments.
5) Successful completion of the registered course and requisite CIE score (PP) is mandatory for the award of degree.
6) These courses are not considered for vertical progression, calculation of SGPA & CGPA, however it is mandatory for the award of degree.
7) The guidelines is applicable to all the remaining IV to VI semesters.

Additional courses for Lateral Entry students:

1) The lateral entry students getting admitted from the 2nd year of programme, shall register, study and complete additional courses prescribed & offered time to time.
2) Successful completion of the registered course and requisite CIE score (PP) is mandatory for the award of degree.
3) These courses are not considered for vertical progression, calculation of SGPA & CGPA, however it is mandatory for the award of degree.

Self-Learning Courses (SLC) as per the VIII Semester ST&E:

1) Offering and Registration of Self-learning Courses will commence from 3rd Semester itself and continues till the end of the duration of study.
2) Both regular & lateral entry students shall start registering for the self learning courses and complete as per the guidelines published separately. (Refer to the Self Learning Courses guidelines published).
3) These courses are not considered for vertical progression.
4) Calculation of SGPA & CGPA is considered for VIII Semester, irrespective of period or time of completion of the course.

Emerging Technology Course - 1	
Course Code	**Course Title**
23CDE311	Object Oriented Programming with Java
23CDE312	Python Programming for Data Science
23CDE313	Data Analytics with R
23CDE314	Intoduction to Cyber Security

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AUTONOMOUS SCHEME (Tentative) UG - BE 2nd Year

SCHEME: 2023 **Date of release: 29/06/2024**

SEM: III **Additional courses for Lateral Entry students**

Note:

1) For the fulillment of successful completion of degree, lateral entry students, shall study & complete additional courses as per the guidelines released time to time.
2) Regular courses (SL No 1 to 8) are same as applicable to all defined in the scheme of teaching & examinations (ST&E).
3) The below prescribed courses has to be registered whenever they are offered and successfully completed before the end of Seventh Semester End Examinations.

SL No	Course Type	Course type Count	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O	CIE Marks	SEE			Tot. Marks
								Lecture	Tutorial	Practical	PBL/ABL/ SL/othrs.		Dur.	Th. Mrks	Lab. Mrks.	
For CS stream (CSE/ISE/AIML/CSE(DS))																
9	BSC	-	23MAT31A	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50
For EE stream (ECE & EEE)																
9	BSC	-	23MAT31B	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50
For CV stream (Civil)																
9	BSC	-	23MAT31C	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50
For ME stream (Mechanical)																
9	BSC	-	23MAT31D	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50

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Department of Computer Science and Engineering (Data Science)

Self Learning Course Details

Self-Learning course - 1 (NPTEL)			Self-Learning course - 2 (NPTEL)		
Course Code	**Course Title**	**NPTEL Code**	**Course Code**	**Course Title**	**NPTEL Code**
23DSS101	**Probability for Computer Science**	106104233	**23DSS201**	**Introduction to Artificial Intelligence**	106102220
23DSS102	**Python for Dat Science**	106106212	**23DSS202**	**Introduction Database System**	106106220
23DSS103	**Algorithm Game Theory**	noc24-cs86	**23DSS203**	**Introduction to IOT**	106105166
23DSSS104	**Introduction to Data Analytics**	110106072	**23DSS204**	**Computer Networks and Network Protocol**	106105183
23DSS105	**Data Analytics with Python**	106107220	**23DSS205**	**Linear Algebra**	111106135
23DSS106	**Introduction to Machine Learning**	106106139	**23DSS206**	**Deep Learning for Computer Vision**	106106224
23DSS107	**Introduction to Machine Learning IITKGP**	106105152	**23DSS207**	**Responsible & Safe AI Systems**	noc24-cs132
23DSS108	**Programming Data Structures and Algorithm in Python**	106106145	**23DSS208**	**Probability Theory for Data Science**	noc24-ma64
23DSS109	**Artificial Intelligence: Search Methods for Problem Solving**	106106226	**23DSS209**	**Linear Programming and its applications to computer science**	106104356

Guidelines for Self-learning courses – Under Graduation (UG)

1) All the UG students to earn totally 06 credits by studying and completing 02 NPTEL/SWAYAM courses of 12 weeks each earning 03 credits.
2) The credits so earned by successful completion of the courses will be credited in the 8th SEM grade card.
3) The successful completion of the courses means earning of the course completion certificates from NPTEL/SWAYAM.
4) The courses shall be studied and completed starting from 3rd Semester and shall be completed before the announcement of 8th Semester End Examinations. However, it is advised to complete both the courses before the 7th SEM of their graduation.
5) The respective department BOS shall identify the professional courses related to the respective discipline either core or multidisciplinary from the list of courses released by NPTEL/SWAYAM every season. At least ten such courses shall be identified and finalized after the discussions in the respective BOS meetings, and the list shall be approved by the Academic Dean.
6) The approved list shall be published by the departments to the students at the beginning of the 3rd SEM itself and the student shall be given an option to choose up to 02 courses for the study and earn certificates of completion.
7) The practicing of studying and completion of NPTEL/SWAYAM courses starting from 3rd SEM itself has multi-fold effect:
   i) Enhances the self-learning ability of the students.
   ii) Study of self-learning courses will have impact on the learning of other courses in the scheme of teaching & examinations.
   iii) Will address the real time challenges/difficulties/differences in the calendars of NPTEL/SWAYAM & Institution.
8) The respective departments shall make holistic efforts to bring awareness to the students about the objectives and importance of self-learning courses. The departments shall thrive towards fulfilment of the objectives.
9) The departments shall continuously monitor & track the progress of the accomplishment of the courses by the students.
10) The departments shall assign course mentors as per the guidelines of the NPTEL/SWAYAM.

11) The departments shall take care that the registered courses and the examinations shall be under the local chapter of the Institution.
12) Every care must be taken by the departments to guide, motivate, to help the students in completing the courses as the academic calendar of the institution and the calendar of the NPTEL/SWAYAM doesn't match.
13) Every season new courses may be added to the identified list and a fresh list of courses shall be prepared based on the list announced by the NPTEL/SWAYAM every season. However, the courses published from the first list shall be maintained if the NPTEL/SWAYAM list has the courses.
14) An option for making fresh choice shall be given to the students until the successful completion of the courses and earning of required number of credits within the defined time.
15) The list of students registered for the courses and completion of the courses shall be submitted to the dean office on completion of every season.
16) The performance of the students in the assignments and the certification exam of the NPTEL/SWAYAM shall be considered for awarding the grade points to the students in the self-learning courses.
17) The students unable to complete the self-learning courses and earn the required credits will not be awarded the degree. Degree shall be awarded only after successful completion and earning of credits.

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 2nd Year

Dept. of Computer Science and Engineering (Data Science)

SCHEME: 2023 **SEM: IV** **Revision Date: 8/26/2024**

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/AB L/ SL/etc.		Dur.	Th.	Lab	Tot.
1	BSC	4	23CDT401	Probability Distribution and Statistical Methods	Maths	Maths	**3**	2	2	0	@	50	03	50	-	100
2	PCC	2	23CDT402	Analysis & Design of Algorithms	CSE(DS)	CSE(DS)	**3**	3	0	0		50	03	50	-	100
3	IPCC	3	23CDI403	Data Science for Engineers	CSE(DS)	CSE(DS)	**4**	3	0	2		50	03	50	-	100
4	IPCC	4	23CDI404	Database Managament System	CSE(DS)	CSE(DS)	**4**	3	0	2		50	03	50	-	100
5	PCCL	2	23CDL405	Analysis & Design of Algorithms Lab	CSE(DS)	CSE(DS)	**1**	0	0	2		50	03	-	50	100
6	ETC	2	23CDE42y	Emerging Technology Course - 2	CSE(DS)	CSE(DS)	**3**	3	0	0	@	50	03	50	-	100
7	HSMC	5	23SFHH06/ 23UHVH07	Bioscience (or) UHV - Universal Human Values	Any Dept	Any Dept	**1**	0	2	0	@	50	02	50	-	100
8	AEC	4	23CDAE41	MongoDB	I.E.	I.E.	**1**	1	0	0	3	50	02	50	-	100
9	NCMC	5	23PDSN04	Mindful Mastery : Aptitude and Soft Skill Integration	I.E.	I.E.	**PP/NP**	0	0	0	2	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							**20**	**15**	**4**	**6**	**7**	**500**		**350**	**50**	**900**

BSC: Basic Science Course; 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 & VI 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.

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

Emerging Technology Course - 2	
Course Code	**Course Title**
23CDE421	Advanced Java & J2EE
23CDE422	Edge Computing
23CDE423	Predictive Analysis
23CDE424	Cloud Computing

Department of Computer Science & Engineering (Data Science)

Semester:	III	**Course Type:**	IBSC		
Course Title: Discrete Mathematics and Graph Theory					
Course Code:	**23CDI301**			**Credits:**	4
Teaching Hours/Week (L:T:P:O)			2:2:2:@	**Total Hours:**	40+(10 –12 lab slots)
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3

I. Course Objectives:

This course will enable students to :

- Provide theoretical foundations of computer science to perceive other courses in the programme.
- Illustrate applications of discrete structures: logic, relations, functions and graphs.
- Describe different mathematical counting techniques.

II. Teaching-Learning Process (General Instructions):

1. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Grading assignments and quizzes and documenting student's progress.
4. Encourage the students for group learning to improve their creative and analytical skills.

III. COURSE CONTENT

III(a) Theory Part

Module-1: Fundamentals of Logic	8Hrs

Fundamentals of Logic: Propositions- Logical connectives, Tautologies, contradictions. Logical equivalence- The Laws of Logic, inverse, converse and contra positive. Logical Implication – Rules of Inference, Quantifiers- Types and uses of quantifiers. Applications to verify the algorithm using Mathematical logic.

*** Application problems to be excluded for SEE.**

Textbook 2: Chapter 1(1.1, 1.2, 1.3, 1.5).

Self Learning: Applications to switching Networks.

RBT Levels: L1, L2 and L3

Module-2: Principles of Counting	8Hrs

Well ordering principle and Mathematical Induction. **Fundamental Principles of Counting:** The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition. Applications to design algorithms.

*** Application problems to be excluded for SEE.**

Textbook 1: Chapter 4(4.1), Chapter 1(1.1 to 1.4). **Self Learning:** The Catalan Numbers.	
RBT Levels:L1, L2 and L3	
Module-3: Relations and Functions	8Hrs
Relations and Functions: Cartesian products and Relations, Functions – plain and one-to-one, onto functions. Function Composition and Inverse functions (without proof). **Relations:** Properties of Relations, Computer Recognition – Zero-one matrices and Directed graphs, Partial orders – Hasse diagrams, Equivalence relations and Partitions. Applications to map inputs to outputs in algorithms and represent the relation between the nodes. *** Application problems to be excluded for SEE.** **Textbook 1:** Chapter 5.1, 5.2, 5.6 **Self Learning:** Sterling numbers of second kind, Pigeonhole principle, Topological Sorting.	
RBT Levels: L1, L2 and L3	
Module-4: Fundamentals of Graph Theory	8Hrs
Introduction to Graph Theory: Definitions and Examples, Sub graphs, Complements and Graph Isomorphism. Vertex degree: Euler trails and circuits, planar graphs .Graph coloring and chromatic polynomials. Illustrative examples on Traveling salesman problem. *** Illustrative examples to be excluded for SEE.**	
Textbook 1: Chapter 11.1, 11.2, 11.3, 11.4, 11.6.	
Self Learning: Hamiltonian paths and cycles.	
RBT Levels: L1, L2 and L3	
Module-5: Trees and Connectivity	8Hrs
Trees – properties, pendant vertex, Distance and centers in a tree - Rooted and binary trees, counting trees, traversals, spanning trees. **Connectivity Graphs:** Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, separability, Menger's Theorem, Fundamental circuits. Application to organizing and searching data. **Application problems to be excluded for SEE.** **Textbook 3:** Chapter 3.1 to 3.8, 4.1 to 4.5. **Self Learning:** Matchings , Coverings.	
RBT Levels: L1, L2 and L3	

III(b) Practical Part

Using python/MATLAB software, demonstrate the operation of the following.

Sl. No.	Experiments
1	Program on logical connectives (AND, OR, NOT, XOR).
2	Check whether the given proposition is a tautology or not.

3	Compute the sum of first n odd numbers using mathematical induction.
4	Calculation of Permutation and combination.
5	Implement functions to check whether a given function is one-to-one and onto (Example: $f(x)=x^2$).
6	Check whether the relation is equivalence or not.
7	Implement the Fibonacci sequence using both an iterative approach and a recursive approach.
8	Program to verify a given relation forms a partial order or not. [Example: elements = [1, 2, 3, 4], Relation = [(1, 1), (1, 2), (2, 2), (2, 3), (3, 3), (3, 4), (4, 4)]].
9	Program on assign colors to the vertices of a graph, no two adjacent vertices share the same color.
10	Implement the Travelling Salesman Problem (TSP) using a Hamilton Path approach to find the shortest Hamilton Path in a weighted graph.
11	Write a program to find the maximum number of edge-disjoint paths between two vertices. Use the Edmonds-Karp algorithm, an implementation of the Ford Fulkerson method for computing the maximum flow in a flow network.
12	Using Menger's theorem, find the minimum vertex cut between source and target.

IV. COURSE OUTCOMES

CO1	Illustrate the basic concepts of mathematical logic and Graph theory.
CO2	Apply the knowledge of mathematical logic, counting principles, Relations and functions, Graph theory to compute problems in various fields of Engineering.
CO3	Analyse the solutions of problems using mathematical logic and graphical techniques.
CO4	Develop the programs and algorithms on discrete mathematical structure and graphs.

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
CO1	3	2	1		2							1	1	1
CO2	3	2	1		2							1	1	1
CO3	3	2	1		2							1	1	1
CO4	3	2	1		2							1	1	1

VI. Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Name of the publisher	Edition and Year
1	Discrete and Combinatorial Mathematics	Ralph P. Grimaldi	Pearson Education	5th Edition 2020
2	Discrete Mathematics and its Applications	Kenneth H. Rosen	McGraw Hill	8th Edition 2021

3	Graph Theory With Application to Engineering and Computer Science	Narsingh Deo	Prentice Hall of India	Latest edition 2016
VII(b): Reference Books:				
1	Discrete Mathematical Structures: Theory and Applications	D.S. Malik and M.K. Sen	Cengage Learning	4th Edition 2010
2	Discrete Mathematics with Applications	Thomas Koshy	Elsevier	5th Edition Reprint 2018
3	Introduction to graph theory	Douglas B. West	Prentice Hall	3rd Edition 2014
VII(c): Web links and Video Lectures (e-Resources):				
1. http://nptel.ac.in/courses.php?disciplineID=111 2. http://www.class-central-central.com/subject/math(MOOCs) 3. http://academiccarth.org/ VTU EDUSAT programme-20				
VIII: Activity Based Learning				
Assignments, Quiz, Presentation.				

Department of Computer Science and Engineering (Data Science)

Semester:	III	**Course Type:**	PCC		
Course Title:	**Data Structures and its Applications**				
Course Code:	23CDT302			**Credits:**	03
Teaching Hours/Week (L: T: P: O) {O – Other pedagogies, mention @}			3:2:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	3.00 Hrs

Pre prerequisite: Programming using C

I. Course Objectives:

- To explain the fundamentals of data structures and their applications essential for implementing solutions to problems.
- To illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs.
- To develop Solutions to problems using Arrays, Structures, Stack, Queues, Linked Lists.
- To explore usage of Trees and Graph for application development.
- To apply the hashing techniques in mapping key value pairs.

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
Introduction: Data Structures, Classifications (Primitive & Non-Primitive), Data structure operations (Traversing, inserting, deleting, searching, and sorting). Review of Arrays. Structures: Array of structures Self-Referential Structures. Dynamic Memory Allocation Functions. Demonstration of representation of Polynomials and Sparse Matrices with array. **Textbook1**:Chapter1: 1.2, Chapter2: 2.3-2.5, **Textbook2**: Chapter1: 1.1 - 1.4,	
RBT Levels: L1, L2, L3	
Module-2:Linear Data Structures: Stack and Queues	8 Hrs
Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays. Different representation of expression. Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion. **Queues:** Definition, Array Representation of Queues, Queue Operations, Circular Queues, Queues and Circular queues using Dynamic arrays, Dequeues, Priority Queues. **Textbook1:** Chapter 3: 3.1-3.4, 3.6	
RBT Levels: L1,L2,L3	
Module-3:Linked Lists	8 Hrs
Linked Lists: Definition, classification of linked lists. Representation of different types of linked Lists in Memory, Traversing, Insertion, Deletion, Searching, Sorting, and Concatenation Operations on Singly linked list, Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queue Applications of Linked lists–Polynomials, Sparse matrix representation. Programming Examples. **Textbook1**: Chapter 4: 4.1–4.4,4.5,4.7,4.8	
RBT Levels: L1, L2, & L3	
Module-4:Trees	8 Hrs
Trees: Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees – Evaluation of Expression. **Textbook1**: Chapter 5: 5.1–5.3, 5.5, 5.7	
RBT Levels: L1, L2, & L3	
Module-5: Graphs	8 Hrs
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Traversal methods: Breadth First Search and Depth First Search. **Hashing:** Hash Table organizations, Hashing Functions, Static and Dynamic Hashing **Textbook 1**: Chapter6: 6.1– 6.2.1,6.2.2, Chapter 8: 8.1 - 8.3	
RBT Levels: L1,L2,L3	

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

CO1	Explain various data structures and their practical applications.
CO2	Apply stack and queue concepts effectively to solve problems.
CO3	Demonstrate the practical applications of linked lists in real-world scenarios.

CO4	Describe tree structures and apply them to solve practical problems.
CO5	Apply graph and hashing techniques proficiently to handle key-value pairs and resolve collisions.

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
CO1	3	2	1								2	1	2	
CO2	2	2	1								1	1	2	1
CO3	3	2	2								2	2	2	1
CO4	3	2	2								2	1	2	1
CO5	3	2	2								1	1	2	

VI : Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 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	Fundamentals of Data Structures in C	Ellis Horowitz and Sartaj Sahni	Universities Press	2ndEd,2014

VII(b): Reference Books:

1	Handbook of Data Structures and Applications,	Dinesh P Mehta, and SartajSahni	2nd edition ,28 October 2004	Chapman and Hall/CRC
2	Data Structures using C	Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein	Fifth Edition 2007	Pearson Education
3	Data Structures: A Pseudo code approach with C	Gilberg and Forouzan	2nd Ed, 2014	Cengage Learning
4	An Introduction to Data Structures With Applications	Jean Paul Tremblay & Paul G. Sorenson	2nd Ed, 2013	McGraw Hill

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

- http://nptel.ac.in/courses/106103069
- www.nptel.iitm.ac.in/video.php?subjectId=106105085
- www.cse.unt.edu/~rada/CSCE3110/Lectures/Trees.ppt
- www.nptel.iitm.ac.in/video.php?subjectId=106105085
- cslibrary.stanford.edu/103/LinkedListBasics.pdf
- https://aa.bbs.tr/lab /cen215-datastructures/DataStructures-Using-C2ndedition.pdf

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

Assignments, Quizzes and Seminar

Department of Computer Science and Engineering (Data Science)

Semester:	III	**Course Type:**	IPCC		
Course Title: Digital Design & Computer Organization					
Course Code:			**23CDI303**	**Credits:**	04
Teaching Hours/Week (L: T: P: O)			3:0:2:0	**Total Hours:**	40+8-10 slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

Pre prerequisite: Basic electronics, programming fundamentals, computer basics and digital logic,

I. **Course Objectives:**

1. To demonstrate the functionalities of the binary logic system.
2. To explain the workings of combinational and sequential logic systems.
3. To understand the basic structure of a computer system.
4. To illustrate the workings of I/O operations and the processing unit.

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:	**8 Hrs**

Introduction to Digital Design: Binary Logic, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, and 3.9.

Key Points:

- Module 1 introduces fundamental concepts in digital design, including Boolean algebra, logic gates, and hardware description languages.
- It covers topics related to circuit representation, simplification, and implementation.

Recommendation:

If you want both comprehensive content and the option for local storage, Module 1 would be a better choice.

RBT Levels: L1, L2, L3

Module-2:	**8 Hrs**

Combinational Logic: Introduction to Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decoders, Encoders, Multiplexers, **HDL Models of Combinational Circuits**: Adder, Multiplexer, Encoder.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, and 4.12.

Key Points:

- Module 2 focuses on combinational logic, which deals with circuits that produce outputs based solely on their inputs.
- It covers topics related to designing combinational circuits, such as adders, decoders, and multiplexers. Additionally, it introduces sequential logic, including storage elements like latches and flip-flops.

Recommendation:

If you want to understand both combinational and sequential logic, Module 2 provides a broader perspective.

RBT Levels: L1, L2, L3

Module-3:	**8 Hrs**

Sequential Logic: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops, **Shift Registers**: Types of Registers, Applications of Shift Registers, **Counters:** Asynchronous and Synchrouns Counters, Mod -N Counter.

Text book 1: 5.1, 5.2, 5.3, 5.4.

Key Points:

- Module 3 delves into the fundamental structure of computers, including functional units and operational concepts.
- It covers topics related to processor clocks, performance metrics, and machine instructions.

Recommendation:

- If you want a deeper understanding of computer organization and programming, Module 3 is a better fit.

RBT Levels: L1, L2, L3	
Module-4:	**8 Hrs**
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance –Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes. **Textbook 2:Chapter:1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5**	
Key Points: • Module 4 focuses on input/output organization, interrupt handling, and memory access. • It covers topics related to managing I/O devices, handling interrupts, and optimizing memory access. • Additionally, it explores cache memory design and mapping techniques. **Recommendation:** • If you want to dive deeper into I/O systems, interrupt handling, and memory optimization, Module 4 is the recommendation	
RBT Levels: L1, L2, L3	
Module-5:	**8 Hrs**
Input / Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices. **Basic Processing Unit:** Some Fundamental Concepts, Register Transfers, Performing ALU operations. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance **Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1, 7.1, 7.2, 8.1**	
Key Points: • Module 5 focuses on the fundamental concepts of the basic processing unit (CPU). • It covers topics related to register transfers, ALU operations, memory access, and instruction execution. • Additionally, it explores pipelining, which enhances CPU performance by overlapping instruction execution stages. **Recommendation:** • If you want to delve into CPU architecture, instruction execution, and performance optimization, Module 5 is the recommendation.	
RBT Levels: L1, L2, L3	
III(b). PRACTICAL PART.	
Sl. No.	**Experiments**
PART-A	
1	**Given Simplifying a 4-Variable Logic Expression:** • To simplify a 4-variable logic expression, you can use techniques such as Karnaugh maps or the Quine-McCluskey method. • **Karnaugh Maps (K-Maps):** K-maps help simplify Boolean expressions by grouping adjacent cells with the same output value. You can create a 4-variable K-map and identify groups to obtain a simplified expression • **Quine-McCluskey Method:** This method involves tabulation and prime

	implicants to minimize Boolean functions with more than 4 input variables. • **Once you've simplified the expression, you can simulate it using basic gates.**
2	**Designing a 4-Bit Full Adder and Subtractor:** • A 4-bit full adder adds two 4-bit numbers and produces a 4-bit sum along with a carry-out. • A 4-bit subtractor subtracts one 4-bit number from another and produces a 4-bit difference along with a borrow-out. • **You can design these circuits using basic gates (AND, OR, XOR, etc.) and simulate them.**
3	**Verilog HDL for Simple Circuits:** • You can implement simple circuits in Verilog HDL using different modeling styles • **Structural Modeling**: Describes the circuit using interconnected modules (gates, flip-flops, etc.). • **Data Flow Modeling:** Describes the circuit behavior based on data flow (assign statements, continuous assignments). • **Behavioral Modeling:** Describes the circuit behavior using procedural blocks (always, initial blocks). • **Choose the appropriate modeling style based on your requirements.**
4	**Verilog HDL for Binary Adder-Subtractor:** • Implement both half adder and full adder circuits in Verilog HDL, • Combine them to create a binary adder-subtractor that can perform addition or subtraction based on control signals. • Simulate the design using basic gates.
5	**Verilog HDL for Decimal Adder:** • Design a Verilog module that adds two decimal numbers (BCD representation) and produces the decimal sum. • Use basic gates and simulate the circuit.
6	**Verilog Program for Multiplexers:** • Create Verilog modules for 2:1, 4:1, and 8:1 multiplexers. • Implement them using basic gates and simulate their behavior.
7	**Verilog Program for De-Multiplexers:** • Design Verilog modules for different types of de-multiplexers (1:2, 1:4, etc.). • Simulate their functionality.
8	**Verilog Program for Flip-Flops:** • Implement Verilog modules for SR, JK, and D flip-flops. • Simulate their behavior using basic gates.
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	

CO1	Apply K-Map techniques to efficiently simplify Boolean expressions.
CO2	Design different types of combinational and sequential circuits along with Verilog programs.
CO3	Describe the fundamentals of machine instructions, addressing modes, and processor performance.
CO4	Explain the approaches involved in achieving communication between the processor and I/O devices.
CO5	Analyze the internal organization of memory and the impact of cache/pipelining on processor performance.

V: CO-PO-PSO MAPPING

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

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations.

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 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	Digital Design with an Introduction to Verilog Design,	M. Morris Mano & Michael D. Ciletti	5thEdition	Pearson Education.
2	Computer Organization	Carl Hamacher, Zvonko Vranesic, SafwatZaky,	5th, Edition	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	Digital Principles and Design	Donald D. Givone	1st Edition, 2002	Tata McGraw-Hill Publishers, ISBN: 9780070529069.
2	Computer Organization and Architecture Designing for	William Stallings	11th Edition, 2019	Pearson, ISBN 9780134997193.

	Performance,			
3	Logic and Computer Design Fundamentals	M. Morris Mano Charles Kime	4th Edition 2014	Pearson, ISBN 13: 978-1-292-02468-4.
4	Digital Design and Computer Architecture	David M Harris, Sarah L Harris	2nd Edition,2013	Elsevier Morgan Kaufmann Publishers, ISBN: 978-0-12-394424-5.

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

- https://cse11-iiith.vlabs.ac.in/

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

Assignments, Quizzes, Seminar and also, assign the group task to design the various types of counters and display the output accordingly

Semester:	III	**Course Type:**	IPCC		
Course Title: OPERATING SYSTEM					
Course Code:	**23CDI304**			**Credits:**	04
Teaching Hours/Week (L: T: P: O)			3:0:2:0	**Total Hours:**	40+8 -10 slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

Pre prerequisite: Computer Organisation, C language

I. Course Objectives:

1. To learn how operating systems manage hardware resources, schedule tasks, and provide user-friendly interfaces.
2. To explore efficient strategies for handling CPU, memory, storage, and input/output devices.
3. To demonstrate key APIs and commands for process control, memory allocation, and file system management.
4. To address security risks, including malware and unauthorized access, to maintain system stability and integrity.

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:	**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 and implementation; 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: File system: File concept: Access methods; Directory and Disk structure; File system mounting: File sharing; **Implementing File system:** File system structure; Files 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	
III (b). PRACTICAL PART.	

Sl. No.	Experiments
1	Develop a C program to implement the process system calls (fork(), exec(), wait(), create process, terminate process)
2	Develop a C program that simulates process scheduling algorithms (FCFS and SJF for demonstration).
3	Develop a C program to simulate producer-consumer problem using semaphores.
4	Develop a C programs demonstrating inter-process communication (IPC) using Pipes and Shared Memory.
5	Develop a C program to simulate the following contiguous memory allocation Techniques: a) Worst fit b) Best fit c) First fit.
6	Develop a C program to simulate Bankers Algorithm for Deadlock Avoidance.
7	Develop a C program to simulate page replacement algorithms: a) FIFO b) LRU
8	Develop a C program to simulate SCAN disk scheduling 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.

IV: COURSE OUTCOMES

CO1	Explain the fundamental components and roles of an operating system.
CO2	Apply suitable scheduling algorithms to optimize task execution on the CPU.
CO3	Analyze techniques for managing concurrent processes and preventing deadlocks.
CO4	Implement strategies for efficient memory allocation and utilization
CO5	Demonstrate strategies for organizing and accessing files and secondary storage.

V: CO-PO-PSO MAPPING

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

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 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.	Operating System Principles	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	8th edition, 2015	Wiley-India

VII(b): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	Understanding Operating system	Ann McHoes Ida M Fylnn	6th edition	Cengage Learning
2.	Operating systems: A concept-based approach	D M Dhamdhere	3rd , 2013	McGraw
3.	Operating systems	William Stallings	6th	Pearson

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

- https://youtu.be/vBURTt97EkA
- https://www.youtube.com/watch?v=783 KAB-tuE4&list=PLIemF3uozcAKTgsCj82 voMK3 TMROYE_f
- https://www.youtube.com/watch?v3TLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6 mkO

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

Assignments, Quizzes, PBL and Seminar

Department of Computer Science & Engineering (Data Science)

Semester:	III	**Course Type:**	**PCCL**		
Course Title:			**Data Structures Lab**		
Course Code:	23CDL305			**Credits:**	01
Teaching Hours/Week (L:T:P:O) {O – Other pedagogies, mention @}			0:0:2:0	**Total Hours:**	15.00
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Practical**			**Exam Hours:**	3.00

Pre-Prerequisite: Programming using C

II. **Course Objectives:**

1. To learn the fundamental types of data structures, their implementation, and their applications.
2. To understand the significance of using appropriate data structures for effective programming.
3. To develop the ability to identify suitable data structures in problem-solving.

III. **Teaching-Learning Process (General Instructions):**

- Implement all the programs in "C" Programming Language and Linux OS.

PART-A

Sl. No.	List of Laboratory Experiments
1	Design, Develop and Implement a menu driven Program in C for the following Array operations ➢ Inserting an Element (ELEM)at a given valid Position (POS) ➢ Deleting an Element at a given valid Position (POS) ➢ Display of Array Elements ➢ Exit. Support the program with functions for each of the above operations.
2	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.
3	Design, Develop and Implement a programming C for the following Stack Applications Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ Solving Tower of Hanoi problem with n disks.
4	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) ➢ Insert an Element on to Circular QUEUE ➢ Delete an Element from Circular QUEUE ➢ Demonstrate Overflow and Underflow situations on Circular QUEUE ➢ Display the status of Circular QUEUE ➢ Exit

	Support the program with appropriate functions for each of the above operations
5	Singly Linked List (SLL)of Integer Data ➢ Create SLL stack of N integer. ➢ Display of SLL ➢ Linear search. Create a SLL queue of N Students Data Concatenation of two SLL of integers.
6	Design, Develop and Implement a menu driven Programming C for the following operations on Binary Search Tree (BST) of Integers ➢ Create a BST of N Integers ➢ Traverse the BST in In-order, Preorder and Post Order
7	Design, Develop and implement a program in C for the following operations on Graph (G) of cities ➢ Create a Graph of N cities using Adjacency Matrix. ➢ Print all the nodes reachable from a given starting node in a diagraph using DFS/BFS method.
8	Design and develop a program in C that uses Hash Function H: K->L as H(K)=K Mod m (reminder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.
	PART-B
	A team of two students developed a prototype using the C/C++ language to demonstrate the use of data structures in real-time applications. For example, they used trees to index search results, graphs to navigate places, graphs for recommendations and match-making, queues for message passing, spell and grammar checkers, and matrices to generate survey insights. Their innovative applications of data structures attracted high marks. (Ref: https://www.geeksforgeeks.org/realtime-application-of-data-structures/).

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	Analyze various linear and non-linear data structures.
CO2	Demonstrate the working nature of different types of data structures and their applications.
CO3	Apply appropriate searching and sorting algorithms for the given scenario.
CO4	Apply the appropriate data structure for solving real world problems.

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
CO1	2	2	3	1							2	1	1	2
CO2	2	1	2	1							2	1	1	2
CO3	2	1	2	1							2	1	1	2

CO4	2	1	2	1							2	1	1	2

VI. **Assessment Details (CIE & SEE)**

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 4

Semester End Examination (SEE): Refer Annexure Section 4

VII. **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	An Introduction to Data Structures with Applications	Jean-Paul Tremblay & Paul G. Sorenson	2nd edition , 1st July 2017	Tata McGraw Hill
2	Data Structures using C & C++	Aaron M. Tanenbaum	2nd edition , 2005	PHI Learning
3	Data and File Structures using C	Reema Thareja	2nd edition ,2014	Oxford University Press

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

1	Handbook of Data Structures and Applications,	Dinesh P Mehta, and SartajSahni	2nd edition ,28 October 2004	Chapman and Hall/CRC

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

- https://www.geeksforgeeks.org/realtime-application-of-data-structures

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

case studies, mini projects, self-study activities, group discussions, etc

Department of Computer Science & Engineering (Data Science)

Semester:	III	**Course Type:**	ETC		
Course Title: Object Oriented Programming with Java					
Course Code:	**23CDE311**			**Credits:**	03
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 proficiency in any Programming language

I Course Objectives:

- To acquire proficiency in fundamental constructs of the Java programming language.
- To Comprehend and apply the principles of Object-Oriented Programming (OOP) in Java.
- To acquire expertise in advanced Java concepts including packages, multithreaded programming, and exception handling.

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
Overview of Java: Object-Oriented Programming (Paradigms, Abstraction, Three OOP Principles), Code Blocks, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, Java Keywords). Data Types, Variables, Arrays: Primitive Types, Type Conversion and Casting, Automatic Type Promotion, Arrays, Type Inference with Local Variables. **Operators:** Arithmetic, Relational, Boolean Logical, Assignment, Operator Precedence, Parentheses Usage. **Control Statements:** Selection (if, switch), Iteration (while, do-while, for, For-Each Loop, Nested Loops), Jump Statements (break, continue, return). **Textbook: 1 Chapter: 2, 3, 4, 5**	
RBT Levels: L1, L2	
Module-2	8 Hrs
Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, This Keyword, Garbage Collection. **Methods and Classes:** Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, understanding static, introducing final, Introducing Nested and Inner Classes. **Textbook: 1 Chapter: 6,7**	
RBT Levels: L1, L2	
Module-3	8 Hrs
Inheritance: Inheritance Basics, using super, creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class. **Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods. **Textbook: 1 Chapter: 8, 9**	
RBT Levels: L1, L2,L3	
Module-4	8 Hrs
Packages: Packages, Packages and Member Access, Importing Packages. **Exceptions:** 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. **Textbook: 1 Chapter: 9,10**	
RBT Levels: L1, L2, L3	
Module-5	8 Hrs
Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's	

State.

Enumerations, Type Wrappers and Autoboxing: Enumerations (Enumeration Fundamentals, The values () and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing / Unboxing Boolean and Character Values).

Textbook: 1 Chapter: 11,12

RBT Levels: L1, L2, L3

IV: COURSE OUTCOMES

CO1	Demonstrate proficiency in writing simple programs involving branching and looping structures.
CO2	Design a class involving data members and methods for the given scenario.
CO3	Exert the concepts of inheritance and interfaces in solving real world problems.
CO4	Apply the concept of packages and exception handling in solving complex problem
CO5	Employ the concepts of multithreading, auto boxing and enumerations in program development

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**
CO1	1	1	3		2						2	2	1	3
CO2	1	3									1	1	1	1
CO3	2	1	2		1						1	1	1	2
CO4	2	3	2	2	2						1	1	1	2
CO5	1	2	3		2						2	1	1	2

VI :Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1.

Semester End Examination (SEE): Refer Annexure Section 1

VIII. **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	12th Edition, November 2021	McGraw-Hill, ISBN: 9781260463422

VII(b): Reference Books:

1	Programming with Java	E Balagurusamy	6th Edition Mar-2019	McGraw Hill Education, ISBN: 9789353162337.
2	Thinking in Java	Bruce Eckel	Fourth Edition, 2006	Prentice Hall

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

1. Java Tutorial: https://www.geeksforgeeks.org/java/
2. Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
3. Java Tutorial: https://www.w3schools.com/java/

4. Java Tutorial: https://www.javatpoint.com/java-tutorial
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Assignments, Quizzes, and Seminar

Department of Computer Science and Engineering (Data Science)

Semester:	III	**Course Type:**	ETC		
Course Title:			**Python Programming for Data Science**		
Course Code:	**23CDE312**			**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 proficiency in any programming language

I: Course Objectives:

- To Understanding Python constructs and their application in program development.
- To analysing various conditional statements and their practical usage in programming.
- To Learning and applying basic data structures in Python.
- To Demonstrating array manipulations through file data processing.
- To Grasping the utilization of diverse data types within a data analytics framework.

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

Introduction to python: Python Language Essentials: Core components of the Python language. Python Block Structure: Understanding the structure of Python code blocks. Variables and Assignment Statements: Concepts related to variables and assignment statements in Python. Data Types in Python: Exploring various data types available in Python. Operations in Python: Overview of different operations supported by Python. Input/Output in Python: Utilizing simple input and output operations, including print statements. Formatting Print Statements: Techniques for formatting output using print statements in Python.

Text Book 1: Chapter 3 (3.2, 3.3, 3.4, 3.6, 3.7, 3.9 and 3.10)

RBT Levels: L1, L2

Module-2	8 Hrs

Decision structure: Forming Conditions: Creating conditional expressions to control program flow. If Statement: Understanding the basic if statement for conditional execution. If-Else and Nested If-Else: Exploring conditional branching with if-else statements, and nested if-else constructs for multiple conditions. Looping Statements: Introduction to Looping: Understanding the concept and necessity of loops in programming. Python Built-in Functions for Looping: Exploring built-in functions such as range() and enumerate() for efficient looping. Loop Statements: Implementing loop statements like for and while loops for repetitive tasks. Jump Statements: Understanding jump statements like break, continue, and pass for altering loop behaviour.

Text Book 1: Chapter 4 (4.2 to 4.6) , Chapter 5 (5.1 to 5.4)

RBT Levels: L1, L2

Module-3	8 Hrs

Lists: Introduction to Lists: Understanding list concepts and structure in Python. Operations on Lists: Exploring list operations like appending, removing, and accessing elements. **Tuple:** Introduction to Tuples: Understanding tuple basics and their immutability. Operations on Tuples: Exploring tuple operations such as concatenation and repetition. **Set:** Introduction to Sets: Understanding set data structure and creation methods. Operations in Sets: Exploring set operations like union, intersection, and difference.

Dictionary: Understanding dictionaries as key-value pairs. Operations on Dictionaries: Exploring dictionary operations like adding, updating, and deleting elements. Nested Dictionaries: Understanding and working with nested dictionaries. **Looping:** Looping Over Dictionaries: Iterating over dictionary elements using for loops. Practical Applications: Understanding how to use loops for dictionary manipulation and data processing.

Text Book 1: Chapter 7 (7.2 to 7.3), Chapter 8 (8.1 to 8.4) and Chapter 9(9.1 to 9.3, 9.7 to 9.12)

RBT Levels:L1,L2,L3

Module-4	8 Hrs

The NumPy: Ndarray: Understanding fundamental data structure. Basic Operations: Exploring mathematical and logical operations. Indexing, Slicing, and Iterating: Techniques for element manipulation. Conditions and Boolean Arrays: Utilizing Boolean arrays for filtering. Array Manipulation: Reshaping, resizing, and concatenating arrays. General Concepts: Overview of broadcasting and universal functions. Reading/Writing Array Data: Techniques for file operations. **Pandas:** Data Structures: Overview of Series and DataFrame. Functionalities on Indexes: Exploring hierarchical indexing. Operations Between Data Structures: Merging, joining, and concatenating. Function Application and Mapping: Applying functions for data transformation

Text Book 2: Chapter 3 and Chapter 4.

RBT Levels: L1, L2, L3

Module-5	8 Hrs

The pandas: Introduction to Pandas I/O tools. Reading CSV and Textual Files. Reading/Writing HTML Files. Reading Data from XML Files. Reading Data from Excel Files. Reading JSON Data. Pickle Serialization. **Pandas Data Manipulation:** Data Preparation: Techniques for cleaning and preprocessing. **Concatenating Data:** Combining datasets. Data Transformation: Sorting, filtering, and replacing values. **Discretization and Binning:** Grouping continuous data. Permutation: Reordering data. String Manipulation: Text data operations. Data Aggregation: Aggregating data. Group Iteration: Iterating over grouped data.

Text Book 2: Chapter 5 and Chapter 6

RBT Levels: L1, L2, L3

IV: COURSE OUTCOMES

CO1	Explain the Python programming constructs comprehensively.
CO2	Execute looping and conditional constructs proficiently in program development.
CO3	Enforce data structures effectively to solve real-world problems.
CO4	Implement NumPy constructs proficiently for matrix manipulations.
CO5	Demonstrate Panda constructs adeptly for data analytics purposes.

VCO-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
CO1	3	1											1	
CO2	2	3	2	3	1								1	2
CO3	3	3	3	2							1		1	2
CO4	3	2	3										2	2
CO5	3	3	3	2	3								2	2

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1.

Semester End Examination (SEE): Refer Annexure Section 1

VII: Learning Resources

VII(a): Textbooks:

Sl.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the**

No.				publisher
1	Python Programming,	S. Sridhar, J. Indumathi, V.M. Hariharan	1st edition 2023.	Pearson publishers
2	Python Data Analytics	Fabio Nelli	1st Edition, 2015.	Apress, Publishing,
VII(b): Reference Books:				
1	Intro to Python for Computer Science and Data science	Paul Deitel and Harvey deitel	1st edition 2020.	Pearson Publisher
VII(c): Web links and Video Lectures (e-Resources):				
• Nptel: Introduction to Python for Data Science https://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus 5HX88ht7				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Assignments, Quizzes and Seminar				

Department of Computer Science & Engineering (Data Science)

Semester:	III	**Course Type:**	ETC		
Course Title:	**Data Analytics with R**				
Course Code:	**23CDE313**			**Credits:**	03
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

I: Course Objectives:

1. To Gain the knowledge of R Programming Concepts
2. To Explain the concepts of Data Visualization
3. To Explain the concept of Statistics in R.
4. To Work with R charts and Graphs.

II: Teaching-Learning Process (General Instructions):

- Chalk and board, power point presentations
- Online material (Tutorials) and video lectures.
- Demonstration of programming examples.

III: COURSE CONTENT

Module-1:	8 Hrs

Basics of R : Introducing R, Initiating R, Packages in R, Environments and Functions, Flow Controls, Loops, Basic Data Types in R, Vectors

Textbook 1: Chapter 1: 1.1 to 1.7 Chapter 2: 2.1,2.2

Pre-requisites (Self Learning)

RBT Levels: L1,L2,L3

Module-2:	8 Hrs

Basics of R Continued : Matrices and Arrays, Lists, Data Frames, Factors, Strings, Dates and Times

Textbook: Chapter 2: 2.3,2.4,2.5,2.6,2.7.2.8.1, 2.8.2

Pre-requisites (Self Learning)

RBT Levels: L1,L2,L3

Module-3:	8 Hrs

Data Preparation: Datasets, Importing and Exporting files, Accessing Databases, Data Cleaning and Transformation.
Textbook 1: Chapter 3: 3.1,3.2,3.3,3.4

Pre-requisites (Self Learning)

RBT Levels: L1,L2,L3

Module-4	8 Hrs

Graphics using R: Exploratory Data Analysis, Main Graphical Packages, Pie Charts, Scatter Plots, Line Plots, Histograms, Box Plots, Bar Plots, Other Graphical packages.
Textbook 1: Chapter 4: 4.1 to 4.9

Pre-requisites (Self Learning)

RBT Levels: L1,L2,L3

Module-5:	8 Hrs

Statistical Analysis using R Basic Statistical Measures, Normal distribution, Binomial distribution, Correlation Analysis, Regression Analysis-Linear Regression Analysis of Variance
Textbook 1 : Chapter 5: 5.1, 5.3, 5.4, 5.5, 5.6.1, 5.7

Pre-requisites (Self Learning)

RBT Levels: L1,L2,L3

IV. COURSE OUTCOMES

CO1	Describe the structures of R Programming.
CO2	Illustrate the basics of Data Preparation with real world examples.
CO3	Apply the Graphical Packages of R for visualization.
CO4	Employ various Statistical Analysis methods for data analytics.

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
CO1	3	2	2	2	3						2	1	1	1
CO2	3	2	2	2	2						2	2	1	2
CO3	3	2	2	2	3						2	1	2	2
CO4	3	2	2	2	2						2	1	2	2

VI. Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1.

Semester End Examination (SEE): Refer Annexure Section 1

VII. 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	R Programming: An Approach to Data Analytics,	Sudhamathy and C. Jothi Venkateswaran,	2019	MJP Publishers,

VII (b): Reference Books:(Insert or delete rows as per requirement)				
1	An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics.	W. N. Venables, D.M. Smith and the R Development Core Team.	Version 3.0.1 (2013-05-16)	R Development Core Team.
2	Learning R: A Step by Step Function Guide to Data Analysis.	Cotton, R	1st edition, 2013	O'Reilly Media Inc

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

URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. http://www.tutorialspoint.com/r/r_tutorial.pdf
3. https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/intro.html
4. https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html
5. https://www.w3schools.com/r/r_stat_data_set.asp
6. https://rpubs.com/BillB/217355

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

Programming Assignment

Department of Computer Science & Engineering (Data Science)

Semester:	III	**Course Type:**	ETC		
Course Title: Introduction To Cyber Security					
Course Code:	**23CDE314**			**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:					

I: Course Objectives:

- To familiarize cybercrime terminologies and ACTs
- Understanding cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention
- Understand the motive and causes for cybercrime, cybercriminals, and investigators
- Understanding criminal case and evidence, detection standing criminal case and evidence

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

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes,

Cybercrime: The Legal Perspectives, **Cybercrimes:** An Indian Perspective, Cybercrime and the Indian ITA 2000.

Textbook1:Ch1 (1.1 to 1.8).

RBT Levels: L1, L2

Module-2	8 Hrs

Cyber offenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking,

Cybercafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector

Textbook1: Ch2 (2.1 to 2.7).

RBT Levels: L1, L2

Module-3	8 Hrs

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors,Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks.

Textbook1: Ch4 (4.1 to 4.9, 4.12).

RBT Levels: L1, L2

Module-4	8 Hrs

Understanding the people on the scene: Introduction, understanding cyber criminals, understanding cyber victims, understanding cyber investigators. **The Computer Investigation process:** investigating computer crime. **Understanding Cybercrime Prevention:** Understanding Network Security Concepts, Understanding Basic Cryptography Concepts, Making the Most of Hardware and Software Security

Textbook 2: Ch3, Ch 4, Ch 7

RBT Levels: L1, L2

Module-5	8 Hrs

Cybercrime Detection Techniques: Security Auditing and Log Firewall Logs, Reports, Alarms, and Alerts, Commercial Intrusion Detection Systems, Understanding E-Mail Headers Tracing a Domain Name or IP Address.

Collecting and preserving digital Evidence: Introduction, understanding the role of evidence in a criminal case, collecting digital evidence, preserving digital evidence, recovering digital evidence, documenting evidence.

Textbook 2: Ch 9, Ch 10.

RBT Levels: L1, L2

IV: COURSE OUTCOMES

CO1	Describe the Cybercrime Terminologies
CO2	Analyze Cybercrime in mobiles and Wireless devices along with the tools for Cybercrime and Prevention
CO3	Analyze the motive and causes for Cybercrime, Cybercriminals, and Investigators
CO4	Apply the methods for understanding Criminal case and Evidence, detection standing Criminal case and Evidence.

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
CO1	2				1							1	1	
CO2	1	1	3	3	1								1	
CO3	1	2	3	2	1								1	
CO4	1	1	3	1	1								1	

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1.

Semester End Examination (SEE): Refer Annexure 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	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	SunitBelapure and Nina Godbole,	2013	Wiley India Pvt Ltd, ISBN: 978-81- 265-21791
2	Scene of the cybercrime	Debra Little John Shinder and Michael Cross	2nd edition, 2008	Syngress publishing Inc, Elsevier Inc

VII(b): Reference Books:

1	Software Forensics	Robert M Slade,	2005	Tata McGraw Hill, New Delhi
2	Cybercrime	Bernadette H Schell, Clemens Martin	2004	ABC – CLIO Inc, California,
3	Computer Forensics and Investigations	Nelson Phillips and EnfingerSteuart,	2009	Cengage Learning, New Delhi
4	Incident Response and Computer Forensics	Kevin Mandia, Chris Prosise, Matt Pepe	2006	Tata McGraw -Hill, New Delhi

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

1. https://www.youtube.com/watch?v=czDzUP1HclQ

2. https://www.youtube.com/watch?v=qS4ViqnjkC8 3. https://www.trendmicro.com/en_nz/ciso/21/h/cybercrime-today-and-the-future.html
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Assignments and Seminar.

Department of Computer Science and Engineering (Data Science)

Semester:	III	**Course Type:**	AEC		
Course Title: Programming with Java					
Course Code:	**23CDAE31**			**Credits:**	01
Teaching Hours/Week (L:T:P:O) {O – Other pedagogies, mention @}			1:0:0:3	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory/practical/other assessment(mention)			**Exam Hours:**	02

I: Course Objectives:

1. Understand the structure and use of the main method in a Java application.
2. Declare primitive variables, manipulate strings, handle arrays and array lists, and perform type conversions.
3. Implement branching and looping statements for flow control.
4. Construct class definitions, declare and access data members, and understand object-oriented concepts.
5. Implement methods, instantiate objects, and apply access modifiers and method overloading.

II: 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.

III: COURSE CONTENT

III(a). Theory PART

Module-1:Java Fundamentals	Hrs:08

Describe the use of main in a Java application, Perform basic input and output using standard packages, Evaluate the scope of a variable, Comment and document programs.

Textbook:1 Chapter 2: An Overview of Java, Sections: 2.3-2.6

Pre-requisites (Self Learning)

Basic understanding of what programming is and familiarity with concepts like algorithms and flowcharts. Basic knowledge of at least one other programming language (optional but helpful).

RBT Levels: L1 & L2

Module-2:Data Types, Variables, and Expressions	Hrs:08

Heading: Declare and use primitive data type variables,Construct and evaluate code that manipulates strings,Construct and evaluate code that creates, iterates, and manipulates arrays and array lists,Construct and evaluate code that performs parsing, casting, and conversion,Construct and evaluate arithmetic expressions.	
Textbook: Chapter 3: Data Types, Variables, and Arrays, Sections: 3.1-3.5	
Pre-requisites (Self Learning) Basic arithmetic operations (addition, subtraction, multiplication, division).Understanding of mathematical expressions and operator precedence.	
RBT Levels:L5 &L6	
Module-3:Flow Control Implementation	Hrs:08
Construct and evaluate code that uses branching statements, Construct and evaluate code that uses loops.	
Textbook:1 Chapter 5: Control Statements, Sections: 5.4-5.6	
Pre-requisites Basic knowledge of logical operators and constructs. Ability to trace and understand simple flowcharts and pseudo code.	
RBT Levels: L5 &L6	
Module-4:Object-Oriented Programming	Hrs:08
Heading: Construct and evaluate class definitions, Declare, implement, and access data members in classes, Implement code on oops(Encapsulation,Inheritance,Polymorphism,Abstraction,Interface).	
Textbook: 1 Chapter 6: Introducing Classes, Sections: 6.1-6.4	
Pre-requisites Understanding the concepts of classes and objects. Familiarity with terms like inheritance, polymorphism, and encapsulation (basic level).	
RBT Levels: L5 &L6	
Module-5:Exception Handling	Hrs :08
Declare, implement, and access methods,Instantiate and use class objects in programs Troubleshoot syntax errors, logic errors, and runtime errors, Implement exception handling.	
Textbook:1 Chapter 6: Introducing Classes, Sections: 6.8-6.10	
Pre-requisites (Self Learning) Understanding of method overloading and overriding. Familiarity with the concept of constructors and destructors in any programming language.	
RBT Levels:L1 &L2	

III(b). PRACTICAL PART

(Fill this portion III(b) if course type is integrated or else delete this portion, if course type is only practical, delete the theory part III(a) and retain this section)

Sl. No.	**Experiments / Programs / Problems** (insert rows as many required)
1	Develop a Java program to sort the elements in ascending and descending order.
2	Develop a Java program to demonstrate function overloading for the following prototypes. add(int a, int b) add(double a, double b)

3	Develop a Java program using Operator Overloading for overloading Unary minus operator.
4	Develop a Java program to implement Multiple inheritance for performing arithmetic operation of two numbers
5	Develop a Java program using Constructor in Derived classes to initialize alpha, beta and gamma and display corresponding values.
6	Write a Java program to derive a class publically from base class. Declare base class members under public, private and protected
7	Develop a Java program to create a text file, check file created or not, if created it will write some text into the file and then read the text from the file.
8	Create a Java project using OOPS (Ex.ATM Machine, Student Management System, Hospital Management System)

IV: COURSE OUTCOMES

CO1	Proficiently write and execute Java programs with proper structure and documentation.
CO2	Effectively perform data manipulation and conversion using primitive types, strings, arrays, and array lists.
CO3	Utilize control flow statements to create logical and efficient program execution.
CO4	Design and implement classes with appropriate data members and methods, applying object-oriented principles.
CO5	Debug, troubleshoot, and handle exceptions to maintain robust and error-free code.
CO6	Develop comprehensive Java applications that integrate all learned concepts and techniques.

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	1	3	3	2						1	2				
CO2	1	2	2	2	2						2	1				
CO3	2	2	2	2	2						1	2				
CO4	2	2	2	2	1						1	2				
CO5	2	2	3	2	1						2	1				
CO6	2	2	2	2	1						2	1				

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 5

Semester End Examination (SEE): Refer Annexure Section 5

VIII. 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"	11th Edition, 2018	11th Edition, 2018	McGraw-Hill Education
2	"Head First Java"	Kathy Sierra, Bert Bates	2nd Edition, 2005	O'Reilly Media
3	"Effective Java"	Joshua Bloch	3rd Edition, 2018	Addison-Wesley Professional

VII(b): Reference Books:

1	Effective Java	Jashuabloch	2018	Addison-Wesley Professional
2	Java: The Complete Reference	Herbert Schildt	**2018**	McGraw-Hill Education

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

1. Resource Type: Online Tutorial
Link or Title: https://www.w3schools.com/java/default.asp
2. Resource Type: Video Lectures
Link or Title: Oracle's Java Tutorials
Description: Official YouTube channel for Java tutorials by Oracle

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

Seminar, Assignments, Quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Department of Computer Science and Engineering (Data Science)

Semester:	III	**Course Type:**	NCMC		
Course Title: Skilful Futures: Empowering Aptitude and Soft skills					
Course Code:	**23PDSN03**			**Credits:**	PP/NP
Teaching Hours/Week (L: T: P: O) {O – Other pedagogies, mention @}			0:0:0:2	**Total Hours:**	24
CIE Marks:	50	**SEE Marks:**	NA	**Total Marks:**	50
SEE Type:	NA			**Exam Hours:**	00

I: Course Objectives:

- To strengthen logical and analytical thinking skills required to solve quantitative problems.
- To discuss the importance of ethical considerations in leadership and negotiation, emphasizing integrity, fairness, and accountability in decision-making and interactions.
- To apply problem-solving strategies to real-world situations.
- To crafting Effective Openings and Closings.
- To develop a systematic approach to creative problem solving

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:Quantitative Aptitude-1	6Hrs

Problems on Permutation and Combination. Problems on Surds and Indices

Textbook : Textbook (b) -1: Section –I Page no: 308-373; page no 375-408

Prerequisites: Basic knowledge of Mathematics

Module-2:Visualize Leadership and Negotiation skills	4Hrs

Leadership skills, Persuasion Skills, Negotiation Skills and Conflict Resolving Skills

Textbook: Textbook 5: Chapter-1

Module-3:Quantitative Aptitude – 02	6 Hrs

Problems on Percentage, Problems on Profit and Loss , Problems on cubes and Dices.

Textbook : Textbook (b) -1 Section –I Page no: 308-373; page no 375-408

Prerequisites: Basic Calculation Knowledge.

Module-4:Letter and Writing Skills	4Hrs

Writing Skills, Formal, Informal Letters, Sample Letters, Business Professional writings and Adaptability in writing style

Textbook : Textbook 4: Chapter-1

Module-5: Logical Reasoning	4Hrs

Syllogism Concepts and Logical Deduction

Text book : Textbook 3; Chapter1 to 3

Prerequisites: Basic concepts of Set theory/ Venn diagrams

IV: COURSE OUTCOMES:

CO1	Solve complex problems related to Arithmetic, algebra, geometry, StatisticsPermutation and Combination, demonstrating a strong understanding of the concepts.
CO2	Apply Surds and Indices concepts proficiently to solve mathematical problems with precision.
CO3	Develop leadership skills, including effective communication, persuasion, negotiation, and conflict resolution techniques.
CO4	Demonstrate proficiency in solving Percentage, Profit and Loss, and cubes and Dices problems, showcasing quantitative aptitude.
CO5	Enhance writing skills by effectively composing formal and informal letters, business professional writings, and adapting writing styles to different 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	S4
CO1	2	2						2				1	1		2	1
CO2								2	2			2		2		
CO3	2	2						2				2			1	
CO4										2		2				2

CO5	2	2										1	1	1		1

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure-1 Section 8

Semester End Examination (SEE): Refer Annexure-1 Section 8

VII: Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Fastrack Objective Arithmetic	Rajesh verma	2022	Arihant Publications
2	Algebra Booster	RejaulMarkshud	2017	Mcgraw Hill Education
3	Sense and Syllogism	AparnaTulpule	2019	Whitefalcon
4	A Handbook on letter writing	S.C Gupta	2018	Arihant publications
5	"Leadership Theory and practice"	Peter.GNorthouse	2021	SAGE

VII(b): Reference Books:

1	Quantitative Aptitude for Competitive examination	R S Agarwal	2017	S Chand
2	Are we leading?	Kaushik Mahaputhra	2020	Notion press
4	A modern approach to logical reasoning	R S Agarwal	2019	S Chand

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

- https://youtu.be/6B-dvOMTeV8?si=Mx0GqAVqjh6VtDRP
- https://youtu.be/MFj7QIXn-mM?si=AQlxLi086k1GrJuk

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

Assignments, Quizzes and Seminar, group discussions etc.

Semester:	IV	**Course Type:**	BSC		
Course Title: Probability Distributions and Statistical Methods					
Course Code:	**23CDT401**			**Credits:**	3
Teaching Hours/Week (L: T: P: O)			2:2:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

This course will enable students to :

- To facilitate the students with a concrete foundation of probability distributions.
- Understand the concepts of sampling distributions.
- Learn the concepts of curve fitting and statistical techniques.

II. Teaching-Learning Process (General Instructions):

1. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Grading assignments and quizzes and documenting students' progress.
4. Encourage the students for group learning to improve their creative and analytical skills.

III. COURSE CONTENT

Module-1: Curve fitting and Statistical Techniques	8Hrs

Curve fitting by method of least squares: $y = ax+b$, $y = ax^2 +bx+c$ and $y= ab^x$, Correlation–Karl Pearson's coefficient of correlation, Regression analysis – lines of regression (without proof)-problems, Rank correlation.

Applications of multiple regression in performance tuning and optimization in software engineering.

*** Application problems to be excluded for SEE**

Textbook1: Chapter 24(24.4 to 24.6, 24.8) ,Chapter 25(25.12 to 25.14, 25.16).

Self Learning: Angle between two regression lines, problems, Fitting of the curve $y= ax^b$

RBT Levels: L1, L2 and L3

Module-2: Probability Distributions	8Hrs

Review of basic probability theory. Random Variables (Discrete and Continuous). Probability mass and density functions. Mathematical expectation, Mean and variance. Discrete probability distributions: Binomial, Poisson and Normal distributions (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Applications to analyze the performance of the algorithms. *** Application problems to be excluded for SEE.**	
Textbook1: Chapter 26.7 to 26.10, 26.14 to 26.17.	
Self Learning: Geometric distribution and Exponential distribution.	
RBT Levels:L1, L2 and L3	
Module-3: Two dimensional Random variables and Stochastic process	8Hrs
Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient. **Stochastic process:** Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems. Applications to rank web pages based on their importance. *** Application problems to be excluded for SEE).**	
Textbook2: Chapter 31(31.1 ,31.2).	
Self Learning: Conditional density function.	
RBT Levels: L1, L2 and L3	
Module-4: Sampling distributions	8Hrs
Introduction to Sampling distributions, Standard error, Type-I and Type-II errors. Test of hypothesis for means. Confidence limits for means, Student's t-distribution, Chi-square distribution as a test of goodness of fit. F-distribution. **Textbook1:** Chapter 27 (27.1 to 27.8, 27.10 to 27.12, 27.14, 27.15, 27.17, 27.18 and 27.19). **Self Learning:** Point estimation and interval estimation.	
RBT Levels: L1, L2 and L3	
Module-5: Design of Experiments & ANOVA	8Hrs
Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design. **Textbook3: Chapter** 12(12.4, 12.5 ,12.6). **Self Learning:** Analysis of Co-Variance	
RBT Levels: L1, L2 and L3	
IV.COURSE OUTCOMES	
CO1	Illustrate the basic concepts of statistics, probability and sampling theory.
CO2	Apply the knowledge of statistical techniques and probability distributions of Random variables .
CO3	Analyse the concepts of statistics, sampling techniques and probability distributions for models arising in the engineering field.
CO4	Interpret the strength and limitations of statistical data, probability distributions and sampling 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
CO1	3	2	1									1	1	
CO2	3	2	1									1	1	
CO3	3	2	1									1	1	
CO4	3	2	1									1	1	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Name of the publisher
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers
2	Higher Engineering Mathematics	B.V.Ramana	Tata Mc Graw-Hill
3	Probability & Statistics for Engineers & Scientists	Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye	Pearson Education

VII(b): Reference Books:

1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Ed., 2016
2	Advanced Engineering Mathematics	C. Ray Wylie, Louis C. Barrett	McGraw – Hill Book Co.,	6th Ed., 2017
3	Probability & Statistics for Engineers & Scientists	Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye	Pearson Education	9th Ed., 2023.
4	Linear Algebra and its Applications	David C Lay	Pearson Publishers	4th Ed., 2018.

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

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central-central.com/subject/math(MOOCs)
3. http://academiccarth.org/
4. VTU EDUSAT programme-20

VIII: Activity Based Learning

Assignments / Quiz / Presentation.

Department of Computer Science and Engineering (Data Science)

Semester:	IV	**Course Type:**	PCC		
Course Title: ANALYSIS & DESIGN OF ALGORITHMS					
Course Code:	**23CDT402**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O) {O – Other pedagogies, mention @}			3:0:0:0	**Total Hours:**	**03**
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	**100**
SEE Type:	Theory			**Exam Hours:**	**03**
Pre-requisites: Fundamental knowledge in the C/C++ programming language					

I: Course Objectives:

- To Understand how to analyze algorithms and evaluate their performance.
- To State algorithm efficiencies using asymptotic notations.
- To Apply various algorithm design techniques, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
- To Choose appropriate data structures and algorithm design methods for specific applications.
- To Familiarize yourself with the P and NP complexity classes.

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

Introduction-Perspectives: In the field of computer science and algorithmic problem-solving, various business domains and applications benefit from algorithmic techniques.
Business domain: Banking, Finance services, IT, Manufacturing, e-Commerce, Online services and marketing, Logistics and Supply Chain Management, Telecommunication.
Applications: Communication & Networking, Search engines, Machine learning, Database management, Software tools development, Data organization, GPS navigation systems
Introduction to Algorithms: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.
Brute force design technique: Selection Sort and Bubble Sort.
Textbook 1: Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2) **Textbook 2:** Chapter 1(section 1.1,1.2,1.3)

RBT Levels:L1,L2, L3

Module-2	8 Hrs

Divide and Conquer: Merge sort, Quicksort, Multiplication of Long Integers, Strassen's Matrix Multiplication. Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Application of DFS and BFS.
Textbook 2: Chapter 3(Sections 3.1,3.3,3.4,3.5,3.6)
Textbook 1: Chapter 4 (Sections 4.1,4.2,4.3), Chapter 5(Section 5.1,5.2,5.3)

RBT Levels:L1,L2, L3

Module-3	8 Hrs

Transform and Conquer: Presorting, Heapsort, Problem reduction. Space and Time Tradeoffs: Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool's and Boyer-Moore algorithm.
Textbook 2: Chapter 4(Sections 4.1,4.3,4.5)
Textbook 1: Chapter 9(Section 9.1,9.2,9.3,9.4), Chapter 6(section 6.4)

RBT Levels:L1,L2,L3

Module-4	8 Hrs

Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, Knapsack Problem and Memory Functions.
Greedy Technique: Prim's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes, Fractional Knapsack Problem.
Textbook 2: Chapter 5 (Sections 5.1,5.2,5.4,5.9)
Textbook 1: Chapter 8(Sections 8.2,8.4), Chapter 7 (Sections 7.1,7.2)

RBT Levels: L1,L2,L3

Module-5	8 Hrs

Backtracking: N-Queen's Problem, Sum of Subset Problem.
Branch-and-Bound: Travelling Salesperson Problem, Assignment Problem
Decision Trees: Decision Trees for Sorting
NP and NP-Complete Problems: Basic Concepts, Non- Deterministic Algorithms, P, NP, NP Complete, and NP-Hard classes

RBT Levels: L1,L2,L3

IV: COURSE OUTCOMES

CO1	Apply computing knowledge and mathematical principles to analyze and design algorithms.
CO2	Apply divide and conquer methods and decrease and conquer techniques to solve problems, and then analyze their effectiveness.
CO3	Apply algorithmic principles and theory to model and evaluate computer-based solutions, considering design trade-offs.
CO4	Apply dynamic programming techniques to solve problems, enhancing algorithm time efficiency even if it requires sacrificing space
CO5	Apply and analyze backtracking and branch-and-bound methods, and describe the concepts of P, NP, and NP-Complete problems.

V: CO-PO-PSOMAPPING (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	2	1	2					1		2	2	2		
CO2	1	2	3	1	1					1		2	1	2		
CO3	2	2	3	1	2					1		2	1	1		
CO4	2	2	3	1	2					1		2	1	2		
CO5	1	2	3	1	1					1		2	2	1		

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section **1**

Semester End Examination (SEE): Refer Annexure 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	Introduction to the Design and Analysis of Algorithms	Anany Levitin	3rd Edition, 2012	Pearson, ISBN 13: 978-0-13-231681-1
2	Computer Algorithms/C++,	Ellis Horowitz, SatrajSahni and Rajasekaran,	2nd Edition, 2014,	Universities Press

VII(b): Reference Books:

1	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest,	3rd Edition	PHI.

		Clifford Stein		
2	Introduction to Algorithms	Cormen T.H., Leiserson C.E., Rivest R.L., Stein C.,	3rd Edition, 2010,	PHI, ISBN:9780262 033848.
3	Design and Analysis of Algorithms	S. Sridhar		Oxford Higher Education

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

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS43.html
- https://nptel.ac.in/courses/106/101/106101060/
- http://elearning.vtu.ac.in/econtent/courses/video/FEP/ADA.html
- http://cse01-iiith.vlabs.ac.in/
- http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms

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

1. Assignments, Quizzes and Seminar
2. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification,Peasant, wolf, goat, cabbage puzzle, Konigsberg bridge puzzle etc.,
3. Demonstration of solution to a problem through programming.

Department of Computer Science and Engineering (Data Science)

Semester:	04	**Course Type:**	IPCC		
Course Title: Data Science for Engineers					
Course Code:	**23CDI403**			**Credits:**	04
Teaching Hours/Week (L:T:P:O)			3:0:2:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I: Course Objectives:

- Introduce mathematical foundations required for Data Science
- Learn data analytics problem solving framework
- Introduce the first level Data Science algorithms

II:Teaching-Learning Process (General Instructions):

5. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
6. State the need of Mathematics with Engineering studies to realisereal-life examples
7. Grading assignments, quizzes and documenting students' progress.
8. Encourage the students for group learning to improve their creative and analytical skills.

III: COURSE CONTENT

III (a) Theory part

Module-1: Introduction	Hrs: 8
Introduction to DS, ML and AI, DS and ML Fundamental Concepts: Classification and function approximations, Model forms, Generality of Data Science, Data Classification, viewing ML Algorithms.	
Textbook 1: Chapter 1 & 2: Section 1.1-1.6 , 2.1,2.2,2.4.2, 2.4.3,2.5,2.6	
RBT Levels:L1, L2 and L3	
Module-2: Linear Algebra for DS	Hrs: 8

A framework for solving Data Science Problems, Linear Algebra for DS and ML: Matrix View of Linear Algebra, Fundamental Subspaces, Data Science and Fundamental Subspaces, Solving Linear Equations- Multiple views.	
Textbook 1: Chapter 2& 3: Section 2.7, 3.2,3.3, 3.4, 3.5	
RBT Levels:L1, L2 and L3	
Module-3: Optimization for DS and ML	Hrs: 8
Elements of an Optimization Formation, Discussion of Objective Functions of Classification, First and Second –order Analytical Conditions for Optimality of Unconstrained NLPs, Numerical Approaches to Solving Optimization Problems, Description of Stochastic Gradient Descent.	
Textbook 1: Chapter 4: Section 4.1 – 4.5	
RBT Levels: L1, L2 and L3	
Module-4: Statistical Foundations for DS and ML	Hrs:8
Decomposition of a Data Matrix into Model and Uncertainty Matrcies., Uncertainty Matrcies, Random variables and Probability Mass Functions, Deriving Model Probability Distribution Functions.	
Textbook 1: Chapter 5: Section 5.1, -5.4	
RBT Levels: L1, L2 and L3	
Module-5: Classification Methods	Hrs:8
Types of Classification Problems, Parametric Methods, Non Parametric Methods. Future Directions	
Textbook 1: Chapter 7 &8: Section 7.1- 7.3, 8.1	
RBT Levels: L1, L2 and L3	

III (b) Practical Part

Using Python conduct the following experiments.

Sl. No.	Lab Programs
1.	Develop python program for Basic Data Analysis Process
2.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Find-S algorithm.**
3.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm** to output a description of the set of all hypotheses consistent with the training examples.
4.	Develop python program for Simple Linear Regression
5.	Develop python program for Correlation and scatter plots, Correlation coefficient
6.	Implement Basic Gradient Descent Algorithm
7.	Develop python program for Frequency distributions, Variability, Averages, Normal Curves

8.	Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
9.	Write a program to implement **k-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions.
10.	Implement the non parametric technique locally weighted regression on .csv dataset

IV. COURSE OUTCOMES

CO1	Summarize the fundamental concepts forData Science.
CO2	Incorporate Mathematical Foundations for Modelling.
CO3	Apply Numerical Approaches to Solving Optimization Problems
CO4	Interpret the classification methods of Data Science.

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
CO1	2	1	1									1	1	
CO2	2	2	2									1	1	
CO3	3	2	2									1	1	
CO4	2	1	1	2								1	1	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE) : Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 2

VII: Learning Resources

VII(a):Textbooks:

Sl. No.	Title of the Book	Name of the author	Name of the publisher	Edition and Year
1	Data Science for Engineers	Raghunathan Rengaswamy, Reshmi Suresh	CRC Press	2023

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

https://books.google.co.in/books?id=NPGaEAAAQBAJ&newbks=0&printsec=frontcover&hl=en&redir_esc=y#v=onepage&q&f=false

VIII: Activity Based Learning

Assignments, Quiz, Presentation.

Department of Computer Science and Engineering (Data Science)

Semester:	IV	**Course Type:**	IPCC		
Course Title: DATA BASEMANAGEMENT SYSTEM					
Course Code:			**23CDI404**	**Credits:**	04
Teaching Hours/Week (L: T: P: O)			3:0:2:0	**Total Hours:**	40 + 8-10 slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03
Pre prerequisite: Fundamentals of Computer					

I: Course Objectives:

- To provide a strong foundation in database concepts, technology, and practice.
- To Practice SQL programming through a variety of database problems.
- To understand the relational database design principles.
- To Design and build database applications for real world problems.
- To understand the basic concepts of NOSQL.

To become familiar with database storage structures and access techniques

II. Teaching-Learning Process:

1. The following are some of the strategies that teachers can employ to facilitate the achievement of various course outcomes:
2. **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.
3. **Visual Aids**: Utilize videos and animations to elucidate complex concepts. Visual representations enhance understanding and engagement among students.
4. **Collaborative Learning**: Encourage group learning within the classroom. Collaborative activities foster teamwork, communication, and a deeper grasp of subject matter.
5. **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.
6. **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.
7. **Multiple Representations**: Introduce topics using various representations. Visuals, diagrams, and real-world examples cater to diverse learning styles.
8. **Creative Problem Solving**: Present different approaches to solving the same problem. Encourage students to think outside the box and devise their own innovative solutions.
9. **Real-World Application**: Discuss how each concept relates to practical scenarios. Connecting theoretical knowledge to real-world contexts enhances students' comprehension

and retention.

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

III COURSE CONTENT

III(a). Theory PART

Module-1:Introduction to DBMS	**8 Hrs**

Introduction to databases: Definition, characteristics, advantages of DBMS approach compared to traditional file systems. Different types of database users.

Overview of database languages and architectures: Data models, schemas and instances, three-schema architecture, data independence, Data Languages and Interfaces, Database System Environment.

Conceptual Data Modeling using Entity-Relationship (ER) Model: Entities, attributes, relationships, cardinality, ER diagrams.

Textbook 1:Ch 1.1 to 1.6; 2.1 to 2.4; 3.1 to 3.9

RBT Levels: L1, L2, L3

Module-2: Relational Model	**8 Hrs**

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.

Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.

Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Textbook 1: Ch 5.1 to 5.3; Ch 8.1 to 8.5; Ch 9.1 to 9.2

RBT Levels: L1, L2, L3

Module-3: Database Design	**8 Hrs**

Normalization: Introduction to Normalization using Functional and Multi valued Dependencies: Functional Dependencies, Introduction to normalization concepts (1NF, 2NF, 3NF, BCNF), Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Textbook1:Ch 14.1to 14.7

RBT Levels: L1, L2, L3

Module-4: SQL	**8 Hrs**

SQL: SQL data definition and data types, Constraints in SQL, Basic retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL. **SQL:** Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.

Textbook 1: Ch 6.1 to 6.4; Ch 7.1 to 7.4

RBT Levels: L1, L2, L3

Module-5: NOSQL Databases	**8 Hrs**

NoSQL Databases: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j

Textbook 1: Ch 24.1 to 24.6

RBT Levels: L1, L2, L3	
III (b). PRACTICAL PART.	
Sl. No.	**Experiments**
PART-A	
1	Create a table called Student & execute the following. Student (USN, SNAME, PROGRAM_NAME,DOB, CLASS) • Create a user and grant all permissions to the user. • Insert a new student. • Change the class of student 'Smith' to '4-CSE(DS)'. • Delete the record for the student whose name is 'Smith' and student number is 17. • Alter SNAME to STUDENT NAME
2	Queries using aggregate functions (COUNT, AVG, MIN, MAX, SUM), Group by, Order by. Employee(E_id, E_name, Age, Salary) • Create Employee table containing all Records E_id,E_name,Age,Salary. • Count number of employee names from employee table • Find the Maximum age from employee table. • Find the Minimum age from employee table. • Find salaries of employee in Ascending Order. • Find grouped salaries of employees.
3	CreateatablecalledStudent&execute different join operations (INNER,LEFT,RIGHT,FULL). Student table: (Student_ID, Name, Age, Major, GPA) Course table: (Course_ID, Course_Name, Credits) Enrollment table: (Student_ID, Course_ID, Semester, Grade)
4	Consider the schema for College Database: STUDENT (USN, SName, Address, Phone, Gender) SEMSEC (SSID, Sem, Sec) CLASS (USN, SSID) SUBJECT (Subcode, Title, Sem, Credits) IAMARKS (USN,Subcode,SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to 1. List all the student details studying in fourth semester 'C' section. 2. Compute the total number of male and female students in each semester and in each section. 3. Create a view of Test1 marks of student USN '1JB19CS101' in all subjects. 4. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA< 12 then CAT = 'Weak'
5	Create cursor for Employee table & extract the values from the table. Declare the variables,Open the cursor &extract the values from the cursor. Close the cursor. **Employee(E_id, E_name, Age, Salary)**
PART-B	
	A team of 4 students develop database system for any problem selected; make sure that the application should have five or more tables. Indicative areas include: Organization, health

	care, Ecommerce etc.

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

CO1	Explain the fundamental concepts of databases and DBMS.
CO2	Design and implement relational databases using the Entity-Relationship model.
CO3	Apply SQL for creating, manipulating, and retrieving data from relational databases.
CO4	Apply normalization techniques to design efficient and effective database schemas.
CO5	Explain the concept of NOSQL.

V: CO-PO-PSO MAPPING

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

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 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	FundamentalsofDatabaseSystems	RamezElmasri andShamkant B.Navathe	7thEdition,2017,	Pearson
2	Databasemanagement systems	Ramakrishnan,andGehrke	3rdEdition,2014	McGrawHill

VII(b): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Database Systems Concepts	Abraham Silberschatz, Henry K. F. Wong, and Michael Stonebraker	7th Edition	McGraw Hill

VII(c): Web links and Video Lectures (e-Resources):
https://www.coursera.org/learn/relational-database https://www.udacity.com/course/intro-to-relational-databases--ud197 https://www.w3schools.com/sql/ https://www.tutorialspoint.com/dbms/index.htm https://onlinecourses.nptel.ac.in/noc22_cs91/preview
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Assignments, Quizzes, Seminar and Mini Project

Semester:	3	**Course Type:**	PCCL		
Course Title:		**Analysis & Design of Algorithms Lab**			
Course Code:	**23CDL405**			**Credits:**	01
Teaching Hours/Week (L:T:P:O) {O – Other pedagogies, mention @}			0:0:2:0	**Total Hours:**	20
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Practical**			**Exam Hours:**	03

Pre-Prerequisite: Practical knowledge in the C/C++ programming language

I: Course Objectives:

- To learn the methods for analysing algorithms and evaluating their performance.
- To demonstrate the efficiency of algorithms using asymptotic notations.
- To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
- To learn the concepts of P and NP complexity classes.

II: Teaching-Learning Process (General Instructions):

Note: The following programs should be implemented in C/C++ language

PART-A

Sl. No.	List of Laboratory Experiments
1	**Practice Programs:** • Implementation and execution of simple programs to understand running time analysis of non-recursive algorithms • Finding maximum element in a given array. • Linear search, • Bubble sort, • Determine whether all the elements in a given array are distinct. • Given 2 NXN matrices, perform matrix multiplication using brute force approach. • Implementation and execution of simple programs to understand running time analysis of recursive algorithms • Find the Factorial of a given number. • Print Fibonacci series • Given a positive decimal integer n, find the number of binary digits in n's binary

	representation. • To solve tower of Hanoi problem. • Recursive linear search.
Lab Programs:(At-least one application from each of the following group)	
1	Apply divide and conquer strategy to solve sorting problem • Merge sort • Quick sort
2	Apply decrease and conquer strategy to solve graph problem • Breadth first search • Topological sorting using depth first search
4	Apply transform and conquer strategy • Heap sort • Checking element uniqueness after pre-sorting
5	Apply input enhancement strategy to solve string-matching problem • Horspool's algorithm • Boyer – Moore's algorithm
6	Apply dynamic programming strategy to solve optimization problem •Warshall - Floyd's Algorithms, • Knapsack problem solution using memory function.
7	Apply greedy strategy to solve graph problem • Dijkstra's algorithm • Prim's algorithm
PART-B	
	A team of two students developed a prototype using the C/C++ language to demonstrate the use of Design and Analysis of Algorithm in real-time applications. For example, they used trees to index search results, graphs to navigate places, graphs for recommendations and match-making, queues for message passing, spell and grammar checkers, and matrices to generate survey insights. Their innovative applications of data structures attracted high marks.

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:

CO1	Develop programs to solve computational problems using suitable algorithm design strategy.
CO2	Compare algorithm design strategies by developing equivalent programs and observing running times for analysis (Empirical).
CO3	Make use of suitable integrated development tools to develop programs.
CO4	Choose appropriate algorithm design techniques to develop solution to the computational and complex problems.
CO5	Demonstrate and present the development of program, its execution and running time(s) and record the results/inferences.

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	2	1								2	2	2		
CO2	2	3	2	2								2	1	2		
CO3	2	2	3	2								2	1	1		
CO4	2	2	2	3								2	1	2		
CO5	2	2	2	3								2	2	1		

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 4

Semester End Examination (SEE): Refer Annexure Section 4

VII: 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	Introduction to the Design and Analysis of Algorithms	Anany Levitin	3rd Edition, 2012	Pearson, ISBN 13: 978-0-13-231681-1
2	Computer Algorithms/C++,	Ellis Horowitz, SatrajSahni and Rajasekaran,	2nd Edition, 2014,	Universities Press

VII (b): Reference Books:

1	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein	3rd Edition	PHI.
2	Introduction to Algorithms	Cormen T.H., Leiserson C.E., Rivest R.L., Stein C.,	3rd Edition, 2010,	PHI, ISBN:9780262033848.
3	Design and Analysis of Algorithms	S. Sridhar		Oxford Higher Education

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

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS43.html
- https://nptel.ac.in/courses/106/101/106101060/
- http://elearning.vtu.ac.in/econtent/courses/video/FEP/ADA.html
- http://cse01-iiith.vlabs.ac.in/
- http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms

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

4. Assignments, Quizzes and Seminar
5. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification,Peasant, wolf, goat, cabbage puzzle, Konigsberg bridge puzzle etc.,
6. Demonstration of solution to a problem through programming.

Department of Computer Science and Engineering (Data Science)

Semester:	IV	**Course Type:**	ETC		
Course Title:			**Advanced Java & J2EE**		
Course Code:	**23CDE421**			**Credits:**	03
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:					

I: Course Objectives:

- Understanding the fundamental concepts of Enumerations and Annotations
- Apply the concepts of Generic classes in Java programs
- Demonstrate the fundamental concepts of String operations
- Design and develop web applications using Java servlets and JSP
- Apply database interaction through Java database Connectivity

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

Enumerations, Autoboxing and Annotations: Enumerations, Enumeration fundamentals, the values() and valueOf() methods, Java enumerations are class types, enumerations inherits Enum, example, type wrappers, Autoboxing, Autoboxing methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of warning

Annotations: Annotation basics, specifying retention policy, obtaining annotations at run time by use of reflection, Annotated element interface, using default values, Marker Annotations, Single member annotations, Built in annotations

Textbook 1: Chapter12

RBT Levels: L1, L2,L3

Module-2	8 Hrs

Generics: What are Generics, A Simple Generics Example, A Generic Class with Two Type Parameters, The General Form of a Generic Class, Bounded Types, Using Wildcard Arguments, Bounded Wildcards, Creating a Generic Method, Generic Interfaces, Raw types and Legacy code, Generic Class Hierarchies, Erasure, Ambiguity errors, Some Generic Restrictions

Textbook 1: Chapter 14

RBT Levels: L1, L2,L3

Module-3	8 Hrs

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, String Buffer, String Builder

Textbook 1: Chapter 15

RBT Levels: L1, L2, L3

Module-4	8 Hrs

Background; The life cycle of a servlet: A simple servlet; the servlet API; The javax.servlet package Reading servlet parameter; the javax.servlet.http package; Handling HTTP Requests and Responses; using Cookies; Session Tracking,

Java Server Pages (JSP): JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects

Textbook 1: Chapter 31 Textbook 2: Chapter 11

RBT Levels: L1, L2, L3

Module-5	8 Hrs

The concept of JDBC: JDBC Driver Types; JDBC packages; A brief overview of the JDBC Process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Metadata, Data Types; Exceptions.

Textbook 2: Chapter 6

RBT Levels: L1, L2, L3

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

CO1	Explain the fundamental concepts of Enumerations and Annotations
CO2	Apply the concepts of Generic classes in Java programs

CO3	Demonstrate the concepts of String operations in Java
CO4	Develop web-based applications using Java servlets and JSP
CO5	Illustrate database interaction and transaction processing in Java

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
CO1	2											1	1	1
CO2		2	2	2									1	1
CO3		2	2									1	1	1
CO4	3			2	2								1	1
CO5			2		1							1	1	1

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1.

Semester End Examination (SEE): Refer Annexure 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	9th Edition	Tata McGraw-Hill
2	The Complete Reference J2EE,	Jim Keogh	7th Edition	Tata McGraw-Hill

VII(b): Reference Books:

1	Introduction to JAVA Programming	Y. Daniel Liang	7th Edition, 2007	Pearson Education

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.

Dept. of Computer Science & Engineering (Data Science)

Semester:	04	**Course Type:**	ETC		
Course Title: Edge Computing					
Course Code:	**23CDE422**			**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

I: Course Objectives:

- Identify key architectural components of edge computing networks,
- Identify challenges associated with edge networks, potential security vulnerabilities, compare key principles of cyber security,
- Exposure to Edge Analytics with real-time examples

II: Teaching-Learning Process (General Instructions):

9. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
10. State the need for Analytics with Engineering Studies with real-time examples.
11. Grading assignments and quizzes and documenting students' progress.
12. Encourage the students for group learning to improve their creative and analytical skills.

III: COURSE CONTENT

Module-1: **Edge Computing and Its Essentials**	Hrs: 8

Introduction, Edge Computing Architecture, Background Essential: IoT Devices, Networking Architecture, Network Management and Control, Edge Computing State –of-the Art Interfaces and Devices, Edge Computing Simulators.

Textbook – 1: Chapter 2 Section: 2.1-2.7

RBT Levels:L1, L2 and L3

Module-2: **Edge Analytics**	Hrs: 8

Types of Data, Data Analytics, Goal of Data Analytics, Domain Benefiting from Big data Analytics, Real-Time Applications of Data Analytics, Phases & Types of Data Analytics, Edge Data Analytics, Architecture of Data Analytics, Machine Learning for edge devices.

Textbook – 1: Chapter 3 Section: 3.1-3.8 & 3.10,3.11

RBT Levels:L1, L2 and L3	
Module-3: **Edge Data Storage Security**	Hrs: 8
Data Security, Data Confidentiality, Authentication, Privacy –Preserving Schemes , Edge based Attack Detection and Prevention.	
Textbook – 1: Chapter 4 Section: 4.1 - 4.5	
RBT Levels: L1, L2 and L3	
Module-4: **Block Chain and Edge Computing Systems**	Hrs:8
History of Block chain, Distributed Ledger Technology, Role of P2P Architecture in Block chain, Block chain Cryptography, Characteristics of Block chain, Types of Clock chain, Block chain Architecture and Fundamentals, Blockchain platforms, Edge computing with Blockchain.	
Textbook – 1: Chapter 5 Section: 5.1 – 5.10	
RBT Levels: L1, L2 and L3	
Module-5: **Edge Computing Use Cases and Case Studies**	Hrs:8
Module 5: Use cases, Edge Computing High- Potential use cases, Realizing of edge computing in healthcare ensuring storage security.	
Textbook – 1: Chapter 6 Section: 6.1 – 6.3	
RBT Levels: L1, L2 and L3	

IV: COURSE OUTCOMES

CO1	Incorporate Edge Analytics, Edge storage and Block Chain concepts with case studies
CO2	Demonstrate knowledge of edge-computing architectures and their constituents.
CO3	Illustrate the fundamental concepts of block chain and edge computing.
CO4	Analyze an edge ecosystem and identify areas of improvement

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
CO1	2	2	1										2	1
CO1	2	2	2										1	1
CO2	2	2	2										2	1
CO3	1	2	1										1	1

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE)& Rubrics: Refer Annexure Section 1

Semester End Examination (SEE)& Rubrics: Refer Annexure Section 1

VII: Learning Resources

VII(a):Text Books

Sl. No.	Title of the Book	Name of the author	Name of the publisher	Edition and Year
1	Edge Computing Foundamentals, Advances and Applications	K Anitha Kumari, G Sudha Sadasivam, D Dharini, M Niranjanmurthy	CRC Press	First Edition 2022

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

1. Edge Computing | Fundamentals, Advances and Applications | K. Anitha K (taylorfrancis.com)
2. Edge Computing Fundamentals, Advances and Applications... - Google Scholar

VIII: Activity Based Learning

Assignments, Quiz, Presentation.

Department of Computer Science and Engineering (Data Science)

Semester:	IV	**Course Type:**	ETC		
Course Title:			**Predictive Analysis**		
Course Code:	**23CDE423**			**Credits:**	03
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:					

I: Course Objectives:

- Develop theoretical understanding of model ling techniques in data science.
- Formulate complex decision-making problems with data for predictive analysis in business context.
- Analyze and evaluate predictive model outcomes for informing decision-making.

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
Linear Methods for Regression and Classification: Overview of supervised learning,Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection , Ridge regression, Lasso regression , Linear Discriminant Analysis , Logistic regression , Perceptron learning algorithm. **Textbook 1: Chapter 1,2**	
RBT Levels: L1, L2,L3	
Module-2	8 Hrs
Model Assesment and Selection : Bias,Variance,and model complexity,Bias-variance trade off, Optimisim of the training error rate ,Esimate of In-sample prediction error,Effective number of parameters, Bayesian approach and BIC, Cross- validation ,Boot strap methods, conditional or expected test error. Textbook 1: Chapter 3,4	
RBT Levels: L1, L2,L3	
Module-3	8 Hrs
Additive Models,Trees,and Boosting: Generalized additive models, Regression and classification trees , Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting ,Examples (Spam data, California housing , New Zealand fish, Demographic data) **Textbook 1: Chapter 5,6**	
RBT Levels: L1, L2, L3	
Module-4	8 Hrs
Neural Networks(NN) , Support Vector Machines(SVM),and K-nearest Neighbour: Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest – Neighbour classifiers(Image Scene Classification) **Textbook 1: Chapter 31 Textbook 2: Chapter 11**	
RBT Levels: L1, L2, L3	
Module-5	8 Hrs
Unsupervised Learning and Random forests: Association rules, Cluster analysis, Principal Components, Random forests and analysis. Textbook 2: 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 statistical methods and predictive strategies.
CO2	Realize how to validate models and analyse outcomes
CO3	Solving analytics difficulties by using systems and critical thinking.
CO4	Illustrate the modelling techniques in data science.

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
CO1	3				2								1	2
CO2		3	3										1	
CO3				2									1	
CO4				3	2								1	1

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1.

Semester End Examination (SEE): Refer Annexure 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	The Elements of Statistical Learning-Data Mining, Inference, and Prediction ,	Trevor Hastie, Robert Tibshirani, Jerome Friedman ,	Second Edition , , 2009..	Springer Verlag
2	An introduction to statistical learning with applications in R,	G.James,D.Witten,T.Hastie,R.Tibshirani-	2013.	Springer,.
3	Introduction to Machine Learning,	E.Alpaydin,	2010.	Prentice Hall Of India,

VII(b): Reference Books:

1	Introduction to JAVA Programming	Y. Daniel Liang	7th Edition, 2007	Pearson Education

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

- 1. https://www.ibm.com/in-en/analytics/predictive-analytics
- 2. https://www.youtube.com/watch?v=Kd0C-8q0HkI

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

Assignments, Quizzes and Seminar.

Department of Computer Science and Engineering (Data Science)

Semester:	IV	**Course Type:**	ETC		
Course Title:	**Cloud Computing**				
Course Code:		**23CDE424**		**Credits:**	04
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:**	3

- **Pre prerequisite:** Programming Skills, Basics of Security and Privacy, Knowledge of Agile Development, Familiarity with Operating Systems, Understanding of Virtualization, Basics of Networking, Basic Understanding of Different Types of Cloud.

I: Course Objectives:

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

II. Teaching-Learning Process:

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

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films 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. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps

improve the students' understanding.

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

III COURSE CONTENT

Module-1:	**8 Hrs**

Introduction:

Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.comand Salesforce.com, Manjra soft Aneka

Textbook 1: Chapter 1: 1.1,1.2 and 1.3

RBT Levels: L1, L2, L3

Module-2:	**8 Hrs**

Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualizations, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples

Textbook 1: Chapter 3: 3.1 to 3.6

RBT Levels: L1, L2, L3

Module-3:	**8 Hrs**

Cloud Computing Architecture: Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges

Textbook 1: Chapter 4: 4.1 to 4.5

RBT Levels: L1, L2, L3

Module-4:	**8 Hrs**

Cloud Security: Risks, Top concern for cloud users, privacy impact assessment, trust, OSsecurity, VMSecurity, Security Risks posed by shared images and management OS.

Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9

RBT Levels: L1, L2, L3

Module-5:	**8 Hrs**

Cloud Platforms in Industry

Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.

Textbook 1: Chapter 9: 9.1 to 9.2

Cloud Applications:

Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.

Textbook 1: Chapter 10: 10.1 to 10.2

RBT Levels: L1, L2, L3

IV COURSE OUTCOMES

CO1	Understand and analyse various cloud computing platforms and service provider.

CO2	Illustrate various virtualization concepts.
CO3	Identify the architecture, infrastructure and delivery models of cloud computing.
CO4	Understand the Security aspects of CLOUD.
CO5	Define platforms for development of cloud applications

V CO-PO-PSO MAPPING

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

VI Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure 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	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola, and ThamraiSelvi	1st Edition	McGraw Hill Education.
2	Cloud Computing Theory and Practice	Dan C. Marinescu,	2013	Elsevier

VII(b): Reference Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Cloud Computing: A Practical Approach	Toby Velte, Anthony Velte	1st Edition	McGraw-Hill Osborne Media.
2	Cloud Application Architectures: Building Applications and Infrastructure in the Cloud,	George Reese,		O'Reilly Publication.
3	Cloud Computing Explained:	John Rhoton		Recursive Press

	Implementation Handbook for Enterprises			

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

- https://www.youtube.com/watch?v=1N3oqYhzHv4
- https://www.youtube.com/watch?v=RWgW-CgdIk0

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

Assignments, Quizzes, Seminar and also, assign the group task to design the various types of counters and display the output accordingly

Semester:	IV	**Course Type:**	AEC		
Course Title: MongoDB					
Course Code:	**23CDAE41**			**Credits:**	01
Teaching Hours/Week (L:T:P:O) {O – Other pedagogies, mention @}			1:0:0:3	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory/practical/other assessment(mention)			**Exam Hours:**	

I: Course Objectives:

1. Understand MongoDB Fundamentals: Learn the basic concepts, architecture, and principles of MongoDB, a popular NoSQL database.
2. Master Database Operations: Gain proficiency in performing CRUD operations (Create, Read, Update, Delete) and other essential database tasks in MongoDB.
3. Explore Advanced Features: Dive deeper into MongoDB's advanced features such as aggregation, indexing, transactions, and sharding for complex data manipulation and scalability.
4. Establish Connectivity: Set up connections between your applications and MongoDB, including configuring drivers, authentication, and security measures.
5. Optimize Performance: Fine-tune MongoDB performance through efficient query optimization, indexing strategies, and utilization of caching mechanisms to enhance overall system responsiveness and scalability.

II: Teaching-Learning Process (General Instructions):

Chalk & Talk Method, Power Point Presentation, Keynotes, Activity Based, Presentations, Assignment, Subject Viva Voce, Beyond Syllabus.

III: COURSE CONTENT

III(a). Theory PART

Module-1: Mongo DB introduction	Hrs:08

Basic introduction of MongoDB, History and features of Mongodb, NOSQL Database, Advantages over RDBMS, Mongo db Data types and Mongodb shell, Mongo db installation and Mongodb data Modeling.

Pre-requisites

Basic Programming Knowledge

Languages: While MongoDB can be used with multiple programming languages, having a good grasp of at least one programming language like JavaScript, Python, or Java is essential.

RBT Levels: L1 & L2

Module-2: Collection ,Database, Crud Operation	Hrs:08

Creating database and drop database, Creating collection and Drop collection. Insert document, Update Document, Delete Document, Query Document.	
Pre-requisites Understanding of JSON (JavaScript Object Notation), MongoDB stores data in a JSON-like format called BSON (Binary JSON).	
RBT Levels: L5,L6	
Module-3: Miscellaneous, Differences	Hrs:08
Mongodb Sort() , Mongodb limit(), Cassendra v/s MongoDBss , CouchDB vs MongoDB	
Pre-requisites (Self Learning) Basic Database Concepts: SQL vs NoSQL: Understanding the differences between relational databases (SQL) and NoSQL databases is crucial.	
RBT Levels: L1 & L2	
Module-4: Connectivity	Hrs :08
Java with Mongodb , PHP with Mongodb.	
Pre-requisites having a good grasp of at least one programming language like JavaScript, Python, or Java is essential.	
RBT Levels: L5 & L6	
Module-5: Indexing	Hrs:08
Index properties, Index interaction, Manage Indexes, Index Strategies.	
Pre-requisites Understanding how to model data effectively is key to utilizing MongoDB's flexibility.	
RBT Levels:L1 & L2	

III(b). PRACTICAL PART

(Fill this portion III(b) if course type is integrated or else delete this portion, if course type is only practical, delete the theory part III(a) and retain this section)

Sl. No.	**Experiments / Programs / Problems** (insert rows as many required)
1	Connecting MongoDB with Applications Java Integration: Use the MongoDB Java Driver to perform CRUD operations, aggregation, and transactions from a Java application.
2	PHP Integration: Use the MongoDB PHP Library to interact with MongoDB from a PHP application, implementing CRUD operations and more.

IV: COURSE OUTCOMES

CO1	Comprehensive Understanding of MongoDB.
CO2	CRUD stands for Create, Read, Update, and Delete—the four basic operations for interacting with database data:
CO3	Aggregation Framework: A powerful tool for performing data processing and transformations on collections.

CO4	Connecting MongoDB with programming languages involves using respective drivers: Java: Use the MongoDB Java Driver to connect, query, and manipulate MongoDB databases within Java applications.
CO5	Indexing: Creating indexes to improve query performance. Indexes can be on a single field, multiple fields (compound indexes), or specialized (text, geospatial).
CO6	Database Management: Involves tasks like backup and restore, monitoring performance, and managing user access.

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
CO1	2		2		2								2	1
CO2	2		2		2								1	1
CO3	2		2		2								2	
CO4	2		2		2								2	1
CO5	2		2		2								1	1
CO6	2		2		2									

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations.

Continuous Internal Evaluation (CIE): Refer Annexure Section 5

Semester End Examination (SEE): Refer Annexure Section 5

VII: 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	MongoDB: The Definitive Guide	Kristina Chodorow	3rd Edition, 2019	O'Reilly Media
2	MongoDB in Action	Kyle Banker	2nd Edition, 2016	Manning Publications

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

MongoDB University, Official MongoDB Documentation, MongoDB Documentation

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

Seminar, Assignments, Quiz, Case studies, Mini projects, Industry visit, Self-study activities, Group discussions, etc.

Semester:	IV	**Course Type:**	NCMC		
Course Title: Mindful Mastery : Aptitude And Soft Skill Integration					
Course Code:	**23PDSN04**			**Credits:**	PP/NP
Teaching Hours/Week (L: T: P: O) {O – Other pedagogies, mention @}			0:0:0:2	**Total Hours:**	24
CIE Marks:	50	**SEE Marks:**	NA	**Total Marks:**	50
SEE Type:	NA			**Exam Hours:**	00

I: Course Objectives:

- To gain a deep understanding of numerical concepts including place value, fractions, decimals, percentages, ratios, and proportions.
- To acquire skills to prioritize tasks and activities effectively based on their importance and urgency.
- To develop the ability to interpret and utilize various data representations, including tables, charts, graphs, and diagrams.
- To learn to interpret different body language signals and understand their underlying meanings in interpersonal communication.
- To acquire strategies for breaking down complex problems into manageable steps, enhancing problem-solving abilities.

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:Arithmetical Ability	5Hrs
Problems on Pipes Cisterns , Time , Work and Averages **Textbook: Textbook 1; Section-1;Page no-510to525**	
Prerequisites: Have the basic knowledge of Mathematics and logics	
Module-2:Time management and Presentation skills	5Hrs
Misconceptions of Time, Symptoms of Poor Time Management, the 'Five Time Zone' Concept, Elements of Effective Time Management. ABC of presentation / Accent and pronunciation / Practice to Perform / Impact of voice modulation, eye contact and body language during presentation. Evaluation, Feed back **Textbook : Textbook 2; Chapter-2**	
Prerequisites: (Self learning): Basic Presentation ideas and Time management.	
Module-3:Quantitative section and Data Interpretation	5Hrs
Simple interest and compound interest problems, Bar graphs, Pie charts and Line graphs concepts and problem. **Textbook: Textbook 1;Section-I; Page no 641-687**	
Prerequisites: Basic Calculation knowledge.	
Module-4:Body language and Postures	5Hrs
Facial expressions, Gestures, Handshakes, tone of voice, Attitude, Universal vs. Culture specific. **Textbook: Textbook 3**	
Module-5: Mental ability	4Hrs
Puzzle based question and Psychometric based interview Question **Reference link:** https://www.hitbullseye.com/puzzle/logical-puzzle-questions-with-answers.php	

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

CO1	Apply problem-solving techniques in Pipes, Cisterns, Time, Work, and Averages, showcasing arithmetical ability.
CO2	Develop efficient time management skills, recognizing misconceptions, symptoms, and implementing effective strategies.
CO3	Apply quantitative analysis and data interpretation, handling problems in simple interest, compound interest, and graphical data interpretation.

CO4	Apply effective body language and postures in communication, distinguishing universal cues from culture-specific ones.
CO5	Apply mental agility through puzzle-solving and psychometric interview preparation, refining problem-solving and cognitive abilities.

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		3		3				2				1	2		1	2
CO2								2	2			2		2		
CO3	3	2						2	2		2	2	2			
CO4						2		2		2		2		2	2	1
CO5	2	2	3									3	1		2	2

VI: Assessment Details (CIE & SEE)

General Rules: Refer Academic Regulations

Continuous Internal Evaluation (CIE): Refer Annexure Section 8

Semester End Examination (SEE):

VII: Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Quantitative Aptitude for Competitive examination	R S Agarwal	2017	S Chand
2	Time Management	Marc Mincini	2003	Mcgraw Hill
3	Gestures and Body Language	Aparnamajumdar	2017	V& S Publisher

VII(b): Reference Books:

1	Gestures and Body Language	Aparnamajumdar	2017	V& S Publisher
2	A modern approach to logical reasoning	R S Agarwal	2019	S Chand

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

- https://youtu.be/-iQEzSd9QUQ?si=qwWVOnDiky3vyuju
- https://youtu.be/MV00SQU_f7E?si=Rq0EAIZKzCU-EVOp
- https://youtu.be/MV00SQU_f7E?list=PLOoogDtEDyvvDNHO_Ba58OrE567nCzzl2

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

Assignments, Quizzes and Seminar, group discussions etc.

|| Jai Sri Gurudev ||
SRI ADICHUNCHANAGIRI SHIKSHANA TRUST (R)
SJB Institute of Technology
An Autonomous Institution under VTU
Approved by AICTE-New Delhi , Recognized by UGC with 2(f) &12(B)
Accredited by NAAC with 'A+' Grade
#67, BGS Health & Education City, Dr. Vishnuvardhan Road, Kengeri, Bengaluru – 560060.
☎ 080 - 28612445 / 6 080 - 2861 2651 www.sjbit.edu.in academicdean@sjbit.edu.in

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

|| Jai Sri Gurudev ||
SRI ADICHUNCHANAGIRI SHIKSHANA TRUST (R)
SJB Institute of Technology
An Autonomous Institution under VTU
Approved by AICTE-New Delhi , Recognized by UGC with 2(f) &12(B)
Accredited by NAAC with 'A+' Grade
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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.

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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.

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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.

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