Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Four Year B. Sc. Degree Program in Computer Science

(Faculty of Science & Technology)

CBCS Syllabus

S. Y. B. Sc. (Computer Science) Semester –IV

For Department of Computer Science

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2024 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: S. Y. B. Sc. (Computer Science)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Computer Science and related subjects, the Board of Studies in Computer Science at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the Fourth semester of S.Y.B.Sc.(Computer Science), which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A degree in Computer Science subject equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Career in Computer Science is considered one of the most high-paying jobs and is full of opportunities; particularly when India's prowess in information technology industry is recognized across the globe. The pool of talented computer professionals working in IT companies of the USA, Canada and other

countries shows that IT can take a person to higher levels. Numerous IT companies from India employ huge number of computer professionals in their Indian and overseas offices. Students who are interested in programming**,** software development, and have good analytical and reasoning skills may pursue this course. Job opportunities are available for Graduates and Post Graduates in Government as well as Private sector. Graduates may take up the following job posts- Software Engineer, Software Tester, Data Analyst, Project Manager, Network Administrator, Database Administrator and Application Developer.

Overall, revising the Computer Science syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Outcomes (POs)
for
B.Sc. (Computer Science)

PO1. Comprehensive Knowledge and Understanding: Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.

PO2. Practical, Professional, and Procedural Knowledge: Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.

PO3. Entrepreneurial Mindset and Knowledge: Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.

PO4. Specialized Skills and Competencies: Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning: Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.

PO6. Communication Skills and Collaboration: Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.

PO7. Research-related Skills: Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.

PO8. Learning How to Learn Skills: Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.

PO9. Digital and Technological Skills: Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy: Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.

PO11. Value Inculcation and Environmental Awareness: Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.

PO12. Autonomy, Responsibility, and Accountability: Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.

PO13. Community Engagement and Service: Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

Programme Specific Outcomes (PSOs)
for
B.Sc. (Computer Science)

PSO1: Apply fundamental principles and methods of Computer Science to a wide range of applications.

PSO2: Design, correctly implement and document solutions to significant computational problems.

PSO3: Impart an understanding of the basics of our discipline.

PSO4: Prepare for continued professional development.

PSO5: Understand the impact of the IT analyst solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

PSO6: Develop proficiency in the practice of computing.

PSO7: Develop the capacity to study and research independently that will help to develop skills for transition to employment in hardware/software companies.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BOS) in Computer Science

(Academic Year 2025-26 to 2027-28)

Sr.No.	Name of Member	Designation
1.	**Dr. Choudhari Upendra Durgadasrao**	**Chairperson**
2.	**Dr. Kardile Vilas Vasantrao**	Member
3.	**Mr. Mankar Abhijeet Dnyaneshwar**	Member
4.	**Ms. Kulkarni Prajakta Pankaj**	Member
5.	**Ms. Bhagat Asmita Amol**	Member
6.	**Mr. Shah Rahul Adesh**	Member
7.	**Mr. Dixit Purushottam Suresh**	Member
8.	**Dr. Nakate Shashikant C.**	Member
9.	**Ms. Swami Poornima Chandrashekhar**	Member
10.	**Ms. Theurkar Komal Manoj**	Member
11.	**Mr. Chemte Swapnil Pandurang**	Member
12.	**Mrs. Jadhav Lata S.**	Member
13.	**Ms. Gharge J. P.**	Member
14.	**Ms. Shivarkar V. K.**	Member
15.	**Mrs. Shirkande V.Y.**	Member
16.	**Dr. Manisha Bharambe**	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
17.	**Dr. Bhoite Sudhakar D.**	Subject Expert from Outside the Parent University
18.	**Dr. Patki Ulhas S.**	Subject Expert from Outside the Parent University
19.	**Mr. Yadav Preetam**	Representative from industry/corporate sector/allied areas
20.	**Mr. Bhaskar Ranaware**	Member of the College Alumni
21.	**Ms. Sakshi Vargar**	UG Student Representative
22.	**Mr. Adesh Jagtap**	PG Student Representative

Credit Distribution Structure for Three/Four Year Honours/Honours with Research Degree Programme
With Multiple Entry and Exit options as per National Education Policy (2024 Pattern as per NEP-2020)

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T	22
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	--	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/ RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	22
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	22
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	22
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

T = Theory **P =** Practical **DSC =** Discipline Specific Course **OE =** Open Elective **SEC =** Skill Enhancement Course
IKS = Indian Knowledge System **AEC =** Ability Enhancement Course **VEC =** Value Education Course **CC =** Co-curricular Course
VSC= Vocational Skill Course **OJT=** On Job Training **CEP=** Community Engagement Project **FP=** Field Project **RP=** Research Project

Course Structure for F. Y. B.Sc. (Computer Science) (2024 Pattern)

Sem	Course Type	Course Code	Course Title	Course Types	Credits
I	DSC-I (General)	COSST-101-GEN	Descriptive Statistics	Theory	02
		COSST-102-GEN	Statistics Practical – I	Practical	02
	DSC-II (General)	COSMT-101-GEN	Discrete Mathematics	Theory	02
		COSMT-102-GEN	Discrete Mathematics practical using Maxima Software	Practical	02
	DSC-III(General)	COSEL-101-GEN	Basics of Electronics	Theory	02
		COSEL-102-GEN	Electronics Practical-I	Practical	02
	DSC-IV(General)	COS-101-GEN	Basic C Programming	Theory	02
		COS-102-GEN	Computer Science Practical – I	Practical	02
	Open Elective (OE)	COS-103-OE	Internet Awareness	Theory	02
	Skill Enhancement Course (SEC)	COS-104-SEC	Practical on DBMS Using PostgreSQL	Practical	02
	Ability Enhancement Course (AEC)	ENG-104-AEC	-----	Theory	02
	Value Education Course (VEC)	ENV-105-VEC	Environmental Science	Theory	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS	------	Theory	02
	Total Credits				**22**
II	DSC-I (General)	COSST-151-GEN	Statistical Methods	Theory	02
		COSST-152-GEN	Statistics Practical – II	Practical	02
	DSC-II (General)	COSMT-151-GEN	Graph Theory	Theory	02
		COSMT-152-GEN	Graph Theory practical using C Programming	Practical	02
	DSC-III (General)	COSEL-151-GEN	Analog and Digital Circuits	Theory	02
		COSEL-152-GEN	Electronics Practical-II	Practical	02
	DSC-IV (General)	COS-151-GEN	Advanced C Programming	Theory	02
		COS-152-GEN	Computer Science Practical – II	Practical	02
	Open Elective (OE)	COS-153-OE	Introduction to MS-Office	Practical	02
	Skill Enhancement Course (SEC)	COS-154-SEC	Practical on RDBMS Using PostgreSQL	Practical	02
	Ability Enhancement Course (AEC)	ENG-154-AEC	----	Theory	02
	Value Education Course (VEC)	COS-155-VEC	Digital & Technological solutions	Theory	02
	CC	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	Theory	02
	Total Credits				**22**
	Grand Total Semester- I + Semester- II				**44**

Course Structure for S. Y. B.Sc. (Computer Science) (2024 Pattern)

Sem	Course Type	Course Code	Course Title	Course Types	Credits
III	Major Mandatory	COS-201-MRM	Basic Data Structure	Theory	02
	Major Mandatory	COS-202-MRM	Introduction to Web Design	Theory	02
	Major Mandatory	COS-203-MRM	Lab Course based on COS-201-MRM and COS-202-MRM	Practical	02
	Vocational Skill Course (VSC)	COS-204-VSC	Lab Course based on Object Oriented Programming using C++	Practical	02
	Field Project (FP)	COS-205-FP	Field Project	Practical	02
	Minor (Any one) (For B.Sc.(CS)) Statistics, Mathematics, Electronics	COS-206-MN(A)	Foundations of Probability	Theory	02
		COS-206-MN (B)	Groups and Coding Theory		
		COS-206-MN(C)	Communication Electronics		
	Minor (Any one) (For B.Sc.(CS)) Statistics, Mathematics, Electronics	COS-207-MN(A)	Minor Statistics Practical (CS)-I	Practical	02
		COS-207-MN (B)	Groups and Coding Theory Practical using SageMath Software		
		COS-207-MN(C)	Communication Practical Lab		
	Open Elective (OE)	COS-208-OE	Areas in Computer Science	Theory	02
	Subject Specific Indian Knowledge System (IKS)	COS-209-IKS	Indian Knowledge Systems and Evolution in Computer Science	Theory	02
	Ability Enhancement Course (AEC)	MAR-210-AEC HIN-210-AEC SAN-210-AEC	--	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/ NCC-211-CC	To be continued from the Semester – II		02
	Total Credits Semester – III				**22**
IV	Major Mandatory	COS-251-MRM	Advanced Data Structure	Theory	02
	Major Mandatory	COS-252-MRM	Advanced Web Design	Theory	02
	Major Mandatory	COS-253-MRM	Lab Course based on COS-251-MRM and COS-252-MRM	Practical	02
	Vocational Skill Course (VSC)	COS-254-VSC	Core Java	Theory	02
	Community Engagement Project (CEP)	COS-255-CEP	Community Engagement Project	Practical	02
	Minor (Any one) (For B.Sc.(CS)) Statistics, Mathematics, Electronics	COS-256-MN(A)	Continuous Probability Distribution and Testing of hypothesis	Theory	02
		COS-256-MN (B)	Linear Algebra		
		COS-256-MN(C)	Fundamental of Instrumentation Techniques		
		COS-257-MN(A)	Minor Statistics Practical (CS)-II	Practical	02
		COS-257-MN (B)	Mathematics Practical using GeoGebra Software		
		COS-257-MN(C)	Instrumentation Practical Lab		
	Open Elective (OE)	COS-258-OE	Digital Marketing	Practical	02
	Skill Enhancement Course (SEC)	COS-259-SEC	Lab Course based on COS-254-VSC	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC HIN-260-AEC SAN-260-AEC	--	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/	To be continued from the Semester – III		02

		NCC-261-CC			
				Total Credits	**22**
	Grand Total Semester- III + Semester- IV				**44**

S. Y. B. Sc. (Computer Science)

(2024 Pattern)

SEM- IV Syllabus

Implementing from Nov. - 2025

(A.Y. 2025-26)

Credit & Course Structure for S. Y. B. Sc. (Computer Science) (SEM-IV) (2024 Pattern)

Sem	Course Type	Course Code	Title of Course	Course Types	No. of Credits
IV	**Major Mandatory**	COS-251-MRM	Advanced Data Structure	Theory	02
	Major Mandatory	COS-252-MRM	Advanced Web Design	Theory	02
	Major Mandatory	COS-253-MRM	Lab Course based on COS-251-MRM and COS-252-MRM	Practical	02
	Vocational Skill Course (VSC)	COS-254-VSC	Core Java	Theory	02
	Community Engagement Project (CEP)	COS-255-CEP	Community Engagement Project	Practical	02
	Minor (Any one) (For B.Sc.(CS)) Statistics, Mathematics, Electronics	COS-256-MN(A)	Continuous Probability Distribution and Testing of hypothesis	Theory	02
		COS-256-MN (B)	Linear Algebra		
		COS-256-MN(C)	Fundamental of Instrumentation Techniques		
	Minor (For B.Sc.(CS)) Statistics, Mathematics, Electronics	COS-257-MN(A)	Minor Statistics Practical (CS)-II	Practical	02
		COS-257-MN (B)	Mathematics Practical using GeoGebra Software		
		COS-257-MN(C)	Instrumentation Practical Lab		
	Open Elective (OE)	COS-258-OE	Digital Marketing	Practical	02
	Skill Enhancement Course (SEC)	COS-259-SEC	Lab Course based on COS-254-VSC	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC HIN-260-AEC SAN-260-AEC	--	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/NCC-261-CC	To be continued from the Semester – III		02
				Total Credits Semester - III	**22**

SYLLABUS (CBCS as per NEP 2020) FOR S. Y. B. Sc. (Computer Science)
(w. e. from June, 2024)

Name of the Programme	**:** B.Sc. Computer Science
Program Code	: USCOS
Class	**:** S.Y.B. Sc. (Computer Science)
Semester	**: IV**
Course Type	**:** Major
Course Name	**:** Advance Data Structures (TH)
Course Code	**:** COS-251-MRM
No. of Lectures	**: 30**
No. of Credits	**: 02**

Prerequisites:

- Basic knowledge of algorithms and problem solving.
- Knowledge of basic Data Structures.
- Knowledge of CPP Programming Language.

Objective:

1. To understand the basic techniques of algorithm analysis.
2. To understand the different methods of organizing large amount of data
3. To efficiently implement the different data structures
4. To efficiently implement solutions for specific problems
5. To understand various algorithmic strategies to approach the problem solution.
6. To understand the memory requirement for various data structures.
7. To understand various data searching and sorting methods with pros and cons

Course Outcome :

CO1. Use well-organized data structures in solving various problems using recursion.

CO2. Differentiate the usage of various structures in problem solution.

CO3. Understand different structures such as queue, trees, and graph.

CO4. Study the basic operations of Propositional logic and Boolean Algebra.

CO5. Analyse and study various proof techniques.

CO6. Understand basics of memory allocation and how it used.

CO7. To efficiently implement the different data structures.

Unit	Title and Contents	No. of Lectures
Unit 1	**Recursion** 1.1 Simulating recursion using stack 1.2 Recursion Algorithms 1.2.1 Fibonacci Series 1.2.2 Tower of Hanoi	**4**
Unit 2	**Queues** 2.1 Introduction 2.2 Representation - Static & Dynamic 2.3 Operations – Create , Init , Insert , Remove & Display 2.4 Circular queue, priority queue (with implementation) 2.5 Concept of doubly ended queue (Dequeue)	**6**
Unit 3	**Trees** 3.1 Concept & Terminologies 3.2 Binary tree, binary search tree 3.3 Representation – Static and Dynamic 3.4 Operations on BST & Heap Tree – create, Insert, delete, traversals (preorder, inorder, postorder), counting leaf, non-leaf & total nodes , non recursive inorder traversal 3.5 Application - Heap sort 3.6 Height balanced tree- AVL trees- Rotations, AVL tree examples.	**10**
Unit 4	**Graph** 4.1 Concept & terminologies 4.2 Graph Representation – Adjacency matrix, adjacency list, inverse Adjacency list, adjacency multi list, orthogonal list 4.3 Traversals – BFS and DFS 4.4 Spanning Tree 4.5 Applications – AOV network – topological sort, AOE network – critical path	**10**

References:

1. Fundamentals of Data Structures ---- By Horowitz Sahani (Galgotia)
2. Data Structures using C and C++ --- By Yedidyah Langsam, Aaron M. Tenenbaum, Moshe J. Augenstein
3. Introduction to Data Structures using C---By Ashok Kamthane
4. Data Structures using C --- Bandopadhyay & Dey (Pearson)
5. Data Structures using C ---By Srivastav

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	3	1	2	2	2	1	1	3	1
CO2	3	2	1	3	3	1	2	2	2	1	1	3	1
CO3	3	2	1	3	2	1	1	2	2	1	1	2	1
CO4	2	1	1	2	2	1	1	1	1	1	1	2	1
CO5	2	1	1	2	2	1	2	2	1	1	1	2	1
CO6	2	3	1	2	2	1	1	2	2	1	1	2	1
CO7	3	3	1	3	3	1	1	3	3	1	1	3	1

Mapping of CO WITH PO

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO1: 3 - Strongly Related: Understanding data structures and recursion directly contributes to a deep grasp of foundational theories and methodologies.

- **CO2: Differentiate the usage of various structures in problem solution**

PO1: 3 - Strongly Related: Differentiating between data structures involves comprehending their principles and methodologies in the context of problem-solving.

- **CO3: Understand different structures such as queue, trees, and graph**

PO1: 3 - Strongly Related: Knowledge of specific data structures like queues, trees, and graphs is essential for a profound understanding of the field.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO1: 2 - Moderately Related: While propositional logic and Boolean algebra are fundamental concepts, they are more specific to logic design rather than a broad understanding of the entire field.

- **CO5: Analyse and study various proof techniques**

PO1: 2 - Moderately Related: Proof techniques are essential for a deeper understanding of methodologies, but they are more focused on the logic aspect rather than the entire multidisciplinary context.

- **CO6: Understand basics of memory allocation and how it is used**

PO1: 2 - Moderately Related: Memory allocation is a key concept in computer science, contributing to a foundational understanding of how it impacts data structures and algorithms.

- **CO7: To efficiently implement the different data structures**

PO1: 3 - Strongly Related: Efficient implementation of data structures requires a profound understanding of their principles, methodologies, and their role within a broader context.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO2: 2 - Moderately Related: Practical application of data structures and recursion is important, but this CO focuses more on theoretical aspects rather than industry-specific practices or regulations.

- **CO2: Differentiate the usage of various structures in problem solution**

PO2: 2 - Moderately Related: Understanding the appropriate use of different structures is practical, but it doesn't directly address industry standards or ethical considerations.

- **CO3: Understand different structures such as queue, trees, and graph**

PO2: 2 - Moderately Related: Knowledge of data structures is relevant to professional tasks, but this CO is more theoretical and less focused on industry best practices or real-world application.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO2: 1 - Partially Related: While foundational, propositional logic and Boolean algebra have limited direct application to industry standards and real-world professional tasks.

- **CO5: Analyse and study various proof techniques**

PO2: 1 - Partially Related: Proof techniques are essential for academic rigor but have less direct relevance to practical industry tasks and professional skills.

- **CO6: Understand basics of memory allocation and how it is used**

PO2: 3 - Strongly Related: Memory allocation is crucial for practical skills and expertise in software development, aligning well with industry standards and best practices.

- **CO7: To efficiently implement the different data structures**

PO2: 3 - Strongly Related: Efficient implementation of data structures is vital for professional tasks, closely aligning with industry standards and practical expertise.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO3: 1 - Partially Related: While problem-solving skills are valuable, this CO does not directly address entrepreneurial mindset, business principles, or market dynamics.

- **CO2: Differentiate the usage of various structures in problem solution**

PO3: 1 - Partially Related: Differentiating data structures is more technical and less directly related to identifying business opportunities or fostering innovation.

- **CO3: Understand different structures such as queue, trees, and graph**

PO3: 1 - Partially Related: Understanding data structures is essential for technical proficiency but has limited direct connection to entrepreneurial skills or market strategies.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO3: 1 - Partially Related: This CO is focused on logical operations, which do not have a direct impact on entrepreneurial thinking or business principles.

- **CO5: Analyse and study various proof techniques**

PO3: 1 - Partially Related: Proof techniques are more relevant to academic rigor and logical reasoning than to entrepreneurship or market dynamics.

- **CO6: Understand basics of memory allocation and how it is used**

PO3: 1 - Partially Related: Knowledge of memory allocation is crucial for technical tasks but does not directly relate to identifying business opportunities or innovation.

- **CO7: To efficiently implement the different data structures**

PO3: 1 - Partially Related: Efficient implementation is important for technical expertise but does not directly contribute to an entrepreneurial mindset or business acumen.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO4: 3 - Strongly Related: Using data structures and recursion to solve problems demonstrates technical skills and problem-solving abilities, crucial for proficiency in the field.

- **CO2: Differentiate the usage of various structures in problem solution**

PO4: 3 - Strongly Related: Differentiating between data structures involves technical and analytical skills, as well as problem-solving, which align well with proficiency in the field.

- **CO3: Understand different structures such as queue, trees, and graph**

PO4: 3 - Strongly Related: Understanding and applying different data structures reflect technical proficiency and problem-solving capabilities, important for effective communication and leadership.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO4: 2 - Moderately Related: Basic operations in logic and Boolean algebra contribute to analytical abilities and problem-solving but are less directly tied to communication and leadership skills.

- **CO5: Analyse and study various proof techniques**

PO4: 2 - Moderately Related: Proof techniques enhance analytical skills and problem-solving

abilities, supporting technical proficiency, though they are less connected to communication and leadership.

- **CO6: Understand basics of memory allocation and how it is used**

PO4: 2 - Moderately Related: Understanding memory allocation is crucial for technical skills and problem-solving, but it is less directly related to leadership and communication.

- **CO7: To efficiently implement the different data structures**

PO4: 3 - Strongly Related: Efficient implementation of data structures shows technical proficiency and problem-solving skills, which are essential for effective leadership and communication in the field.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO5: 3 - Strongly Related: Applying data structures and recursion to solve problems demonstrates practical application, critical thinking, and problem-solving skills.

- **CO2: Differentiate the usage of various structures in problem solution**

PO5: 3 - Strongly Related: Differentiating data structures involves analyzing and solving complex problems, showcasing creativity and adaptability.

- **CO3: Understand different structures such as queue, trees, and graph**

PO5: 2 - Moderately Related: Understanding these structures is foundational for applying concepts practically, though it's less directly related to complex problem-solving or adaptability.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO5: 2 - Moderately Related: Basic operations in logic and Boolean algebra are essential for problem-solving and critical thinking but are less focused on complex, real-world applications.

- **CO5: Analyse and study various proof techniques**

PO5: 2 - Moderately Related: Studying proof techniques supports critical thinking and problem analysis, but is less directly related to practical problem-solving and adaptability.

- **CO6: Understand basics of memory allocation and how it is used**

PO5: 2 - Moderately Related: Understanding memory allocation aids in practical application and problem-solving but is less focused on creative and complex problem scenarios.

- **CO7: To efficiently implement the different data structures**

PO5: 3 - Strongly Related: Efficient implementation of data structures involves applying learned concepts practically, solving complex problems, and requires creativity and adaptability.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO6: 1 - Partially Related: While solving problems with data structures involves technical communication, it does not directly address effective oral or written communication skills or teamwork.

- **CO2: Differentiate the usage of various structures in problem solution**

PO6: 1 - Partially Related: Differentiating data structures involves technical analysis and communication but does not heavily focus on collaborative or leadership aspects.

- **CO3: Understand different structures such as queue, trees, and graph**

PO6: 1 - Partially Related: Understanding data structures is crucial for technical proficiency but does not directly contribute to communication or teamwork skills.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO6: 1 - Partially Related: Basic operations in logic and Boolean algebra are technical in nature and less related to effective communication or teamwork.

- **CO5: Analyse and study various proof techniques**

PO6: 1 - Partially Related: Proof techniques are important for technical problem-solving but do not focus on collaborative or communication skills.

- **CO6: Understand basics of memory allocation and how it is used**

PO6: 1 - Partially Related: Knowledge of memory allocation is essential for technical expertise but does not directly address communication or leadership qualities.

- **CO7: To efficiently implement the different data structures**

PO6: 1 - Partially Related: Efficient implementation is crucial for technical success but does not directly involve effective communication or teamwork.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO7: 2 - Moderately Related: Using data structures and recursion involves problem-solving and analysis, but it does not directly address formulating research questions or data collection methodologies.

- **CO2: Differentiate the usage of various structures in problem solution**

PO7: 2 - Moderately Related: Differentiating between data structures requires analytical skills and methodology, which is relevant to research but not specifically about formulating research questions or reporting findings.

- **CO3: Understand different structures such as queue, trees, and graph**

PO7: 1 - Partially Related: Understanding data structures is fundamental for technical proficiency but has limited direct relevance to research methodologies and ethics.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO7: 1 - Partially Related: Basic operations in logic and Boolean algebra are more focused on theoretical aspects rather than research skills or data collection.

- **CO5: Analyse and study various proof techniques**

PO7: 2 - Moderately Related: Analyzing proof techniques involves critical thinking and analysis, which are relevant to research, though it does not directly cover data collection or reporting.

- **CO6: Understand basics of memory allocation and how it is used**

PO7: 1 - Partially Related: Understanding memory allocation is essential for technical skills but does not directly relate to research methodology or ethics.

- **CO7: To efficiently implement the different data structures**

PO7: 1 - Partially Related: Efficient implementation is important for technical success but does not directly pertain to research question formulation, data collection, or ethical reporting.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO8: 2 - Moderately Related: Mastery of data structures and recursion involves self-directed learning and adaptation but is somewhat specific to technical skills rather than broad goal-setting.

- **CO2: Differentiate the usage of various structures in problem solution**

PO8: 2 - Moderately Related: Differentiating between data structures requires independent problem-solving and adaptability, though it's focused on technical aspects.

- **CO3: Understand different structures such as queue, trees, and graph**

PO8: 2 - Moderately Related: Understanding various data structures involves self-learning and adapting to technical demands but doesn't directly address broader goal-setting.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO8: 1 - Partially Related: Studying logical operations involves foundational knowledge but is less related to self-directed learning or goal-setting.

- **CO5: Analyse and study various proof techniques**

PO8: 2 - Moderately Related: Analyzing proof techniques involves critical thinking and self-directed study, but the focus is more on academic rather than practical goals.

- **CO6: Understand basics of memory allocation and how it is used**

PO8: 2 - Moderately Related: Understanding memory allocation requires learning and adaptation, though it is more technical and less focused on broader goal-setting.

- **CO7: To efficiently implement the different data structures**

PO8: 3 - Strongly Related: Efficiently implementing data structures demonstrates strong self-directed learning and adaptability, as well as setting and achieving technical goals.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO9: 2 - Moderately Related: Applying data structures and recursion involves using ICT tools for problem-solving and data manipulation, but it is more focused on the theoretical application rather than specific software proficiency.

- **CO2: Differentiate the usage of various structures in problem solution**

PO9: 2 - Moderately Related: Differentiating data structures requires understanding their use in software and information systems, though it does not directly address software proficiency or data analysis tools.

- **CO3: Understand different structures such as queue, trees, and graph**

PO9: 2 - Moderately Related: Understanding these structures is relevant for using appropriate software tools and accessing information sources, but it is more about theoretical knowledge.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO9: 1 - Partially Related: Basic operations in logic and Boolean algebra are foundational for ICT but do not directly involve proficiency in software or data analysis.

- **CO5: Analyse and study various proof techniques**

PO9: 1 - Partially Related: Proof techniques involve critical thinking and logical analysis, which are less directly related to using ICT tools or analyzing data with software.

- **CO6: Understand basics of memory allocation and how it is used**

PO9: 2 - Moderately Related: Understanding memory allocation is relevant to software performance and efficiency, impacting how ICT tools manage and analyze data.

- **CO7: To efficiently implement the different data structures**

PO9: 3 - Strongly Related: Efficient implementation of data structures directly involves using software tools for development and analysis, demonstrating proficiency in ICT and data handling.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO10: 1 - Partially Related: Solving problems with data structures is primarily technical and does not directly address multicultural settings or team dynamics.

- **CO2: Differentiate the usage of various structures in problem solution**

PO10: 1 - Partially Related: Differentiating data structures is a technical skill and does not directly involve working in multicultural settings or leading diverse teams.

- **CO3: Understand different structures such as queue, trees, and graph**

PO10: 1 - Partially Related: Understanding data structures is crucial for technical skills but does not directly relate to multicultural engagement or empathy.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO10: 1 - Partially Related: Basic operations in logic and Boolean algebra are technical in nature and have limited relevance to multicultural settings or leadership.

- **CO5: Analyse and study various proof techniques**

PO10: 1 - Partially Related: Analyzing proof techniques involves logical reasoning and analysis but does not directly pertain to multicultural understanding or team leadership.

- **CO6: Understand basics of memory allocation and how it is used**

PO10: 1 - Partially Related: Memory allocation is a technical topic and does not directly relate to engaging with diverse perspectives or leading teams.

- **CO7: To efficiently implement the different data structures**

PO10: 1 - Partially Related: Efficiently implementing data structures involves technical skills and does not directly address multicultural engagement or leadership qualities.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO11: 1 - Partially Related: Using data structures and recursion is primarily technical and does not directly address ethical values, responsible citizenship, or environmental issues.

- **CO2: Differentiate the usage of various structures in problem solution**

PO11: 1 - Partially Related: Differentiating between data structures is a technical skill and has limited direct relevance to ethical issues or sustainability.

- **CO3: Understand different structures such as queue, trees, and graph**

PO11: 1 - Partially Related: Understanding these data structures is essential for technical proficiency but does not inherently involve ethical considerations or environmental concerns.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO11: 1 - Partially Related: Basic operations in logic and Boolean algebra are technical and focus on theoretical aspects rather than ethical or environmental issues.

- **CO5: Analyse and study various proof techniques**

PO11: 1 - Partially Related: Analyzing proof techniques involves academic and logical reasoning skills but does not directly address ethics, sustainability, or responsible citizenship.

- **CO6: Understand basics of memory allocation and how it is used**

PO11: 1 - Partially Related: Understanding memory allocation is important for technical tasks but does not directly relate to ethical practices or environmental conservation.

- **CO7: To efficiently implement the different data structures**

PO11: 1 - Partially Related: Efficient implementation of data structures focuses on technical efficiency and performance, with limited direct connection to ethical or sustainability issues.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO12: 3 - Strongly Related: Using data structures and recursion effectively demonstrates the ability to apply knowledge independently and manage technical problems, showing responsibility and accountability in a work context.

- **CO2: Differentiate the usage of various structures in problem solution**

PO12: 3 - Strongly Related: Differentiating data structures involves critical thinking and effective decision-making, which are key to managing projects and demonstrating responsibility in problem-solving.

- **CO3: Understand different structures such as queue, trees, and graph**

PO12: 2 - Moderately Related: Understanding various data structures is essential for independent application and project management, though it focuses more on technical understanding than project execution.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO12: 2 - Moderately Related: Basic operations in logic and Boolean algebra contribute to independent problem-solving and analytical skills, which are relevant but not directly tied to project management or accountability.

- **CO5: Analyse and study various proof techniques**

PO12: 2 - Moderately Related: Analyzing proof techniques supports critical thinking and problem-solving, which are important for managing projects and demonstrating responsibility but are more theoretical in nature.

- **CO6: Understand basics of memory allocation and how it is used**

PO12: 2 - Moderately Related: Understanding memory allocation is crucial for managing technical aspects of projects and demonstrating accountability, though it is more specific to technical implementation.

- **CO7: To efficiently implement the different data structures**

PO12: 3 - Strongly Related: Efficient implementation of data structures requires independent application of knowledge and effective project management, reflecting strong responsibility and accountability in work contexts.

- **CO1: Use well-organized data structures in solving various problems using recursion**

PO13: 1 - Partially Related: Using data structures and recursion primarily addresses technical problem-solving and has limited direct connection to community-engaged services or promoting societal well-being.

- **CO2: Differentiate the usage of various structures in problem solution**

PO13: 1 - Partially Related: Differentiating between data structures involves technical analysis, which does not directly relate to community engagement or societal well-being.

- **CO3: Understand different structures such as queue, trees, and graph**

PO13: 1 - Partially Related: Understanding these data structures is crucial for technical skills but does not directly impact community service or societal activities.

- **CO4: Study the basic operations of Propositional logic and Boolean Algebra**

PO13: 1 - Partially Related: Basic operations in logic and Boolean algebra are focused on theoretical aspects rather than community engagement or societal well-being.

- **CO5: Analyse and study various proof techniques**

PO13: 1 - Partially Related: Studying proof techniques supports technical and analytical skills but has limited direct relevance to societal engagement or community service.

- **CO6: Understand basics of memory allocation and how it is used**

PO13: 1 - Partially Related: Understanding memory allocation is important for technical applications but does not directly address community or societal involvement.

- **CO7: To efficiently implement the different data structures**

PO13: 1 - Partially Related: Efficient implementation of data structures focuses on technical efficiency and performance rather than community service or promoting societal well-being.

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SYLLABUS (CBCS as per NEP 2020) FOR S. Y. B. Sc. (Computer Science)
(w. e. from June, 2025)

Name of the Programme : B.Sc. Computer Science
Program Code : USCOS
Class **:** S.Y.B.Sc. (Computer Science)
Semester **: IV**
Course Type **:** Major
Course Name **:** Advanced Web Technology (TH)
Course Code **:** COS-252-MRM
No. of Lectures **: 30**
No. of Credits **: 02**

Prerequisites:

- Basic knowledge of Computers and its concepts.

Course Objectives:

1: To design web pages using HTML5, CSS, JavaScript and Bootstrap.

2: To design dynamic, interactive and elegant Web sites.

4: To analyze a web page and identify its elements and attributes.

5: To create web pages using Cascading Style Sheets. Build dynamic web pages using JavaScript (Client-side programming).

6: To Build dynamic web pages using JavaScript (Client-side programming).

7: To Acquire the basic concepts of the Web with reference to its architecture.

Course Outcomes:

CO1: Students will be able to Design web pages using HTML5, CSS, JavaScript and Bootstrap.

CO2: Students will be able to Design dynamic, interactive and elegant Web sites.

CO3: Students will be able to Analyze a web page and identify its elements and attributes.

CO4: Students will be able to Create web pages using Cascading Style Sheets. Build dynamic web pages using JavaScript (Client-side programming).

CO5: Students will be able to Build dynamic web pages using JavaScript (Client side programming).

CO6: Students will be able to Build dynamic web pages using JavaScript (Client side programming).

CO7: Students will be able to Acquiring the basic concepts of the Web with reference to its architecture.

Unit	Title and Contents	No. of Lectures
Unit 1	**Advanced HTML5** **1.1** The Meter Element **1.2** Working with Multimedia **1.3** Image Mapping **1.4** HTML Canvas **1.5** HTML SVG **1.6** Web Storage: Local storage and session storage	07
Unit 2	**Advanced CSS** **2.1** CSS Box Model **2.2** CSS Fonts **2.3** CSS Text **2.4** CSS Forms **2.5** CSS Transitions **2.6** CSS Animations	07
Unit 3	**Basics of JavaScript** **3.1** Introduction to JavaScript **3.2** JavaScript Basics – Data Types, Control Structure **3.3** JavaScript Functions **3.4** Working with events **3.5** JS Popup boxes	10
Unit 4	**Basics of Bootstrap** **4.1** Introduction to Bootstrap **4.2** Use and Advantages of Bootstrap **4.3** How to get Bootstrap **4.4** Bootstrap Containers, Grids, Carousel, Navbar **4.5** Bootstrap Forms, Radio Button, Checkbox, Dropdowns	06

References:

1. Html & CSS: The Complete Reference, Fifth Edition by Thomas A. Powell and published by McGraw Hill.
2. HTML 5 in simple steps by Kogent Learning Solutions Inc., Publisher Dreamtech Press
3. Head First HTML with CSS & XHTML Book by Elisabeth Freeman and Eric Freeman.
4. The Essential Guide to CSS and HTML Web Design Book by Craig Grannell.
5. JavaScript: The Definitive Guide, Publisher – O'Reilly
6. JavaScript & JQuery: Interactive Front-End Web Development, Publisher – Wiley
7. Bootstrap 5 Foundations, by Daniel Foreman
8. Bootstrap, by Jake Spurlock, Publisher(s): O'Reilly Media, Inc.

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	2	3	3	2	1	3	3	1	1	2	1
CO2	3	3	3	3	3	2	1	3	3	1	1	2	1
CO3	2	2	2	2	2	2	2	2	2	1	1	2	1
CO4	3	3	2	3	3	2	2	3	3	1	1	3	1
CO5	3	3	2	3	3	2	1	3	3	1	1	3	1
CO6	3	3	2	3	3	2	1	3	3	1	1	3	1
CO7	2	1	1	2	2	1	2	2	2	2	1	2	1

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

Justification of Mapping of PO1 with All CO'S

CO1: PO1: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap demonstrates a comprehensive understanding of foundational web development principles, aligning strongly with PO1's focus on fundamental theories and methodologies.

CO2:PO1: Creating dynamic, interactive, and elegant websites requires a profound understanding of advanced web development concepts, which is highly relevant to PO1.

CO3:PO1: Analyzing web pages and identifying their elements and attributes involves applying foundational knowledge, which moderately contributes to a comprehensive understanding of web concepts as outlined in PO1.

CO4:PO1: Creating web pages using Cascading Style Sheets and building dynamic web pages using JavaScript indicates a strong grasp of essential web development techniques, strongly mapping to PO1.

CO5:PO1: Building dynamic web pages using JavaScript showcases the application of client-side programming, demonstrating a solid understanding of programming methodologies, aligning strongly with PO1.

CO6:PO1: Reiterating the building of dynamic web pages using JavaScript emphasizes repeated practice and a strong understanding of client-side programming, making it strongly related to PO1.

CO7:PO1: Acquiring basic web concepts and understanding web architecture provides foundational knowledge, which is moderately related to the comprehensive understanding required in PO1.

Mapping of PO2 with All CO'S

CO1:PO2: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap involves practical skills and knowledge of industry standards, which are essential for professional tasks, aligning strongly with PO2.

CO2:PO2: Designing dynamic, interactive, and elegant websites requires applying best practices and industry standards, making it highly relevant to PO2.

CO3:PO2: Analyzing a web page and identifying its elements and attributes helps develop procedural knowledge, which is moderately related to acquiring practical and professional skills as described in PO2.

CO4:PO2: Creating web pages using CSS and building dynamic web pages using JavaScript involves hands-on skills and understanding of procedural knowledge and best practices, making it strongly related to PO2.

CO5:PO2: Building dynamic web pages using JavaScript requires practical application of client-side programming skills, aligning strongly with the practical and professional aspects of PO2.

CO6:PO2: Emphasizing repeated practice in building dynamic web pages using JavaScript further demonstrates strong practical expertise, making it highly related to PO2.

CO7:PO2: Acquiring basic concepts of the web and understanding its architecture provides foundational knowledge but only partially contributes to the practical and professional skills focus of PO2.

Mapping of PO3 with All CO'S

CO1:PO3: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap provides technical skills that can help identify business opportunities in web development, moderately contributing to an entrepreneurial mindset.

CO2:PO3: Designing dynamic, interactive, and elegant websites can drive innovation in web solutions and attract business opportunities, making it strongly related to fostering an entrepreneurial mindset.

CO3:PO3: Analyzing web pages and identifying elements and attributes can aid in understanding market dynamics and customer preferences, which moderately supports an entrepreneurial perspective.

CO4:PO3: Creating web pages using CSS and building dynamic web pages using JavaScript encourages innovation in web design, contributing moderately to the entrepreneurial mindset.

CO5:PO3: Building dynamic web pages using JavaScript involves creating interactive features, which can foster innovative thinking and moderate entrepreneurial opportunities.

CO6:PO3: Repeated practice in building dynamic web pages using JavaScript also encourages innovative web solutions, moderately contributing to entrepreneurial knowledge.

CO7:PO3: Acquiring basic concepts of the web and its architecture provides foundational knowledge but only partially supports the development of an entrepreneurial mindset.

Mapping of PO4 with All CO'S

CO1:PO4: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap involves technical proficiency and problem-solving skills, which are essential specialized competencies relevant to PO4.

CO2:PO4: Designing dynamic, interactive, and elegant websites requires advanced technical skills, creativity, and problem-solving abilities, making it strongly related to the development of specialized skills and competencies.

CO3:PO4: Analyzing web pages to identify elements and attributes develops analytical skills and supports effective communication about web structure, which moderately aligns with PO4.

CO4:PO4: Creating web pages using CSS and building dynamic web pages using JavaScript fosters proficiency in technical skills and the ability to adapt and innovate in web design, making it strongly related to PO4.

CO5:PO4: Building dynamic web pages using JavaScript enhances problem-solving and technical skills, demonstrating strong alignment with the specialized competencies in PO4.

CO6:PO4: Repeated practice in building dynamic web pages using JavaScript further solidifies technical skills and adaptability, strongly contributing to PO4.

CO7:PO4: Acquiring basic concepts of the web and its architecture provides foundational knowledge that supports analytical abilities and technical communication, moderately related to PO4.

Mapping of PO5 with All CO'S

CO1:PO5: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap involves applying learned concepts and solving practical problems in web development, demonstrating strong analytical reasoning and creativity, which aligns strongly with PO5.

CO2:PO5: Designing dynamic, interactive, and elegant websites requires applying critical thinking and creativity to solve complex design and user experience challenges, making it strongly related to PO5.

CO3:PO5: Analyzing web pages to identify elements and attributes requires critical thinking and analytical reasoning, which moderately supports the capacity for problem-solving as outlined in PO5.

CO4:PO5: Creating web pages using CSS and building dynamic web pages using JavaScript involves solving technical problems and applying web development concepts in practical scenarios, strongly aligned with PO5.

CO5:PO5: Building dynamic web pages using JavaScript showcases the ability to solve client-side programming challenges, demonstrating strong application and problem-solving skills, which are core to PO5.

CO6:PO5: Repeated practice in building dynamic web pages using JavaScript further enhances problem-solving, adaptability, and readiness to tackle complex programming challenges, making it strongly related to PO5.

CO7:PO5: Acquiring basic concepts of the web and its architecture provides foundational knowledge that supports problem-solving and analytical reasoning, making it moderately related to PO5.

Mapping of PO6 with All CO'S

CO1:PO6: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap requires the ability to communicate technical concepts clearly and effectively, both orally and in writing, but collaboration is not a primary focus, making it moderately related to PO6.

CO2:PO6: Designing dynamic, interactive, and elegant websites often involves teamwork and collaboration, and it requires clear communication of design ideas and technical specifications, making it moderately related to PO6.

CO3:PO6: Analyzing a web page and identifying its elements and attributes involves explaining technical details and findings, which requires communication skills. This outcome moderately supports PO6.

CO4:PO6: Creating web pages using CSS and building dynamic web pages with JavaScript involves explaining the development process, which requires good communication skills. However, it only moderately relates to collaboration aspects of PO6.

CO5:PO6: Building dynamic web pages using JavaScript may require collaborating with peers or team members, and effectively communicating the web functionalities, making it moderately related to PO6.

CO6:PO6: Repeated practice in building dynamic web pages involves communication of progress and collaborative problem-solving, but the primary focus is still technical skills rather than communication, making it moderately related to PO6.

CO7:PO6: Acquiring basic concepts of the web and its architecture involves foundational knowledge. While some communication is needed to convey these concepts, it is only partially related to developing strong communication skills or collaborative efforts.

Mapping of PO7 with All CO’S

CO1:PO7: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap involves applying technical skills rather than focusing on research-related skills such as inquiry, data collection, and analysis, making it only partially related to PO7.

CO2:PO7: Designing dynamic, interactive, and elegant websites requires some level of observation and creativity but does not directly focus on research methodologies or formulating research questions, making it partially related to PO7.

CO3:PO7: Analyzing a web page and identifying its elements and attributes involves observational skills and some analytical reasoning, which moderately supports research-related skills, especially in formulating analysis-based questions.

CO4:PO7: Creating web pages using CSS and building dynamic web pages using JavaScript involves some level of inquiry, observation, and analysis during development, moderately contributing to research-related skills.

CO5:PO7: Building dynamic web pages using JavaScript focuses more on applying technical skills than on developing research-based inquiry and analytical methods, making it only partially related to PO7.

CO6:PO7: Repeated practice in building dynamic web pages using JavaScript enhances technical proficiency rather than directly supporting research-related skills, making it partially related to PO7.

CO7:PO7: Acquiring basic concepts of the web and its architecture can involve observational skills and foundational inquiry, which are moderately related to the development of research-related skills as outlined in PO7.

Mapping of PO8 with All CO’S

CO1:PO8: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap requires continuous self-directed learning and adapting to new tools, frameworks, and standards, which aligns strongly with "Learning How to Learn" skills in PO8.

CO2:PO8: Designing dynamic, interactive, and elegant websites involves self-learning of advanced web design techniques and practices, requiring students to independently learn and adapt to evolving web development trends, strongly supporting PO8.

CO3:PO8: Analyzing a web page and identifying its elements and attributes requires some level of independent learning to understand and interpret web development concepts, making it moderately related to PO8.

CO4:PO8: Creating web pages using CSS and building dynamic web pages with JavaScript requires learning various styling and scripting techniques independently, strongly supporting the skills outlined in PO8.

CO5:PO8: Building dynamic web pages using JavaScript involves continual self-learning and adapting to changes in client-side programming practices and libraries, making it strongly related to PO8.

CO6:PO8: Repeated practice in building dynamic web pages using JavaScript requires adapting and learning new features, libraries, or methods, reinforcing independent learning skills, making it strongly related to PO8.

CO7:PO8: Acquiring basic concepts of the web and its architecture involves some self-learning and adapting to new foundational concepts, which moderately supports the skills required in PO8.

Mapping of PO9 with All CO'S

CO1:PO9: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap requires proficiency in digital and technological skills, including the use of various ICT tools and software, making it strongly related to PO9.

CO2:PO9: Designing dynamic, interactive, and elegant websites involves using advanced web development tools and software, demonstrating a high level of digital and technological proficiency, which aligns strongly with PO9.

CO3:PO9: Analyzing a web page and identifying its elements and attributes involves using digital tools to inspect and understand web components, which requires moderate digital and technological skills, making it moderately related to PO9.

CO4:PO9: Creating web pages using CSS and building dynamic web pages with JavaScript involves using various coding tools and environments, demonstrating strong proficiency in digital and technological skills, which strongly aligns with PO9.

CO5:PO9: Building dynamic web pages using JavaScript requires extensive use of ICT tools, debugging software, and other technologies, demonstrating strong digital skills and proficiency, making it strongly related to PO9.

CO6:PO9: Repeated practice in building dynamic web pages using JavaScript further enhances digital skills and the use of various development tools, which strongly supports the requirements of PO9.

CO7:PO9: Acquiring the basic concepts of the web and its architecture involves foundational digital skills and understanding of technological platforms, which moderately relates to the development of digital and technological skills in PO9.

Mapping of PO10 with All CO'S

CO1:PO10: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap focuses on technical skills and does not directly involve multicultural competence or empathy, making it only partially related to PO10.

CO2:PO10: Designing dynamic, interactive, and elegant websites may require considering diverse user experiences and accessibility, but it does not primarily focus on multicultural competence or inclusive spirit, making it partially related to PO10.

CO3:PO10: Analyzing a web page and identifying its elements and attributes involves technical understanding rather than engagement in multicultural settings or demonstrating empathy, making it partially related to PO10.

CO4:PO10: Creating web pages using CSS and building dynamic web pages using JavaScript focuses on technical competencies and does not directly involve leading diverse teams or showing empathy, making it partially related to PO10.

CO5:PO10: Building dynamic web pages using JavaScript is more about technical skills and does not directly connect with multicultural competence, inclusive spirit, or empathy, making it partially related to PO10.

CO6:PO10: Repeated practice in building dynamic web pages using JavaScript focuses on enhancing technical skills rather than multicultural competence or empathy, making it partially related to PO10.

CO7:PO10: Acquiring the basic concepts of the web and its architecture may involve understanding global and diverse perspectives in web accessibility and design, which can moderately contribute to multicultural competence and inclusivity as outlined in PO10.

Mapping of PO11 with All CO'S

CO1:PO11: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap involves technical skills without a direct focus on ethical values, sustainability, or environmental awareness, making it partially related to PO11.

CO2:PO11: Designing dynamic, interactive, and elegant websites is primarily a technical task and does not directly address value inculcation or environmental awareness, making it partially related to PO11.

CO3:PO11: Analyzing a web page and identifying its elements and attributes focuses on technical analysis rather than on ethical or environmental considerations, making it partially related to PO11.

CO4:PO11: Creating web pages using CSS and building dynamic web pages with JavaScript emphasizes technical development and does not directly relate to ethical values or environmental awareness, making it partially related to PO11.

CO5:PO11: Building dynamic web pages using JavaScript focuses on technical skills rather than addressing ethical issues or promoting environmental conservation, making it partially related to PO11.

CO6:PO11: Repeated practice in building dynamic web pages using JavaScript is centered on technical expertise and does not directly involve value inculcation or environmental concerns, making it partially related to PO11.

CO7:PO11: Acquiring basic concepts of the web and its architecture is foundational and does not directly address ethical values or environmental awareness, making it partially related to PO11.

Mapping of PO12 with All CO'S

CO1:PO12: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap involves applying knowledge independently and managing web design tasks, demonstrating moderate responsibility and accountability.

CO2:PO12: Designing dynamic, interactive, and elegant websites requires managing various aspects of web development projects independently, which moderately relates to autonomy and accountability in project management.

CO3:PO12: Analyzing a web page and identifying its elements and attributes involves applying analytical skills independently, which moderately supports the demonstration of responsibility and accountability in work contexts.

CO4:PO12: Creating web pages using CSS and building dynamic web pages with JavaScript involves significant project management, independent problem-solving, and accountability for the development process, strongly aligning with PO12.

CO5:PO12: Building dynamic web pages using JavaScript involves managing programming tasks independently and demonstrating responsibility in the development and implementation of features, strongly supporting PO12.

CO6:PO12:Repeated practice in building dynamic web pages using JavaScript requires effective project management, independent work, and accountability, demonstrating strong alignment with PO12.

CO7:PO12: Acquiring basic concepts of the web and its architecture involves self-directed learning and understanding fundamental principles, which moderately relates to autonomy and responsibility in learning contexts.

Mapping of PO13 with All CO'S

CO1:PO13: Designing web pages using HTML5, CSS, JavaScript, and Bootstrap is primarily a technical skill and does not directly involve community engagement or promoting societal well-being, making it partially related to PO13.

CO2:PO13: Designing dynamic, interactive, and elegant websites focuses on technical skills and does not inherently involve community service or engagement, making it partially related to PO13.

CO3:PO13: Analyzing a web page and identifying its elements and attributes is a technical activity with limited direct connection to community engagement or societal impact, making it partially related to PO13.

CO4:PO13: Creating web pages using CSS and building dynamic web pages using JavaScript involves technical work rather than community service or societal well-being, making it partially related to PO13.

CO5:PO13: Building dynamic web pages using JavaScript is focused on technical skills and does not directly contribute to community engagement or societal well-being, making it partially related to PO13.

CO6:PO13: Repeated practice in building dynamic web pages using JavaScript is centered on technical proficiency rather than on community involvement or service, making it partially related to PO13.

CO7:PO13: Acquiring basic concepts of the web and its architecture is foundational knowledge and does not directly involve community service or engagement, making it partially related to PO13.

SYLLABUS (CBCS as per NEP 2020) FOR S. Y. B. Sc. (Computer Science)
(w. e. from June, 2025)

Name of the Programme : B.Sc. Computer Science
Program Code : USCOS
Class **:** S.Y.B.Sc. (Computer Science)
Semester **: IV**
Course Type **:** Major
Course Name **:** Lab Course Based on COS-251-MRM, COS-252-MRM
Course Code **:** COS-253-MRM
No. of Practicals **: 15**
No. of Credits **: 02**

Course Objectives:

1. To understand different Advanced Data structure and to be able to design and analyze the time and space efficiency of the data structure.
2. To be capable to identity the appropriate data structure for given problem and to understand a systematic approach to organizing, writing and debugging programs.
3. To implement linear and non-linear data structure operations using CPP Programs.
4. To solve problems implementing appropriate data structures.
5. To create web pages using HTML 5 and Cascading Style Sheets (CSS).
6. To build dynamic web pages using JavaScript (Client-side programming).
7. To build dynamic web pages using Bootstrap.

Course Outcomes:

CO1 : Students will understand different Advanced Data structure and to be able to design and analyze the time and space efficiency of the data structure.
CO2 : Students will be capable to identity the appropriate data structure for given problem and to understand a systematic approach to organizing, writing and debugging programs.
CO3 : Students will implement linear and non-linear data structure operations using CPP Programs.
CO4 : Students will solve problems implementing appropriate data structures**.**
CO5 : Students will create web pages using HTML 5 and Cascading Style Sheets (CSS).
CO6 : Students will Build dynamic web pages using JavaScript (Client-side programming).
CO7 : Students will Build dynamic web pages using Bootstrap.

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Assignments

Sr. No.	Assignment Name
Assignment 1	**SET A** : Recursion **SET B**: Be acquainted with audio and video tags
Assignment 2	**SET A** : Recursion **SET B**: Practical Implementation of Image Mapping
Assignment 3	**SET A** : Queue **SET B**: Practical implementation of Canvas
Assignment 4	**SET A** : Queue **SET B**: Practical implementation of SVG
Assignment 5	**SET A** : Queue **SET B** : Practical implementation of all kinds of CSS Fonts and Texts
Assignment 6	**SET A** : Tree **SET B** : Designing of Forms with the help of CSS
Assignment 7	**SET A** : Tree **SET B** : Designing of webpage with the help of CSS Transitions.
Assignment 8	**SET A** : Tree **SET B** : Designing of webpage with the help of CSS Animations.
Assignment 9	**SET A** : Tree **SET B** : Practical implementation of control structures in JavaScript
Assignment 10	**SET A** : Tree **SET B** : Practical implementation of control structures in JavaScript
Assignment 11	**SET A** : Graph **SET B** : Practical implementation of Functions in JavaScript

Assignment 12	**SET A** : Graph **SET B** : Practical implementation of Events in JavaScript
Assignment 13	**SET A** : Graph **SET B** : Practical implementation of JS Pop-up boxes in JavaScript
Assignment 14	**SET A** : Graph **SET B** : Designing and Implementation of Navbars, Carousel in Bootstrap
Assignment 15	**SET A** : Graph **SET B** : Designing and Implementation of Forms, Radio Buttons, Checkbox in Bootstrap

References:

9. Html & CSS: The Complete Reference, Fifth Edition by Thomas A. Powell and published by McGraw Hill.

10. HTML 5 in simple steps by Kogent Learning Solutions Inc., Publisher Dreamtech Press

11. Headfirst HTML with CSS & XHTML Book by Elisabeth Freeman and Eric Freeman.

12. The Essential Guide to CSS and HTML Web Design Book by Craig Grannell.

Mapping of this course with Programme Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	3	1	2	3	2	1	1	2	1
CO2	3	3	1	3	3	2	3	3	2	1	1	2	1
CO3	3	3	1	3	3	1	2	3	3	1	1	3	1
CO4	3	3	2	3	3	2	3	3	2	1	1	3	1
CO5	2	2	3	2	2	3	1	2	3	2	2	2	2
CO6	2	3	3	3	3	3	2	3	3	2	2	3	2
CO7	2	2	3	2	2	3	2	3	3	2	2	2	2

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

Justification of Mapping of PO1 with All CO'S

CO1:PO1: Strongly related as it involves understanding advanced data structures and analyzing their efficiencies.

CO2:PO1: Strongly related since it requires identifying appropriate data structures and applying systematic problem-solving.

CO3:PO1: Strongly related by demonstrating a deep understanding of implementing data structures in programming.

CO4:PO1: Strongly related by solving problems using appropriate data structures, showcasing foundational knowledge.

CO5:PO1: Moderately related by understanding web development fundamentals with HTML and CSS.

CO6:PO1: Moderately related as it involves building dynamic web pages using client-side scripting, showing foundational concepts.

CO7:PO1: Moderately related by using Bootstrap to build dynamic web pages, integrating design principles.

Mapping of PO2 with All CO'S

CO1:PO2: Moderately related as understanding advanced data structures contributes to professional knowledge in software development.

CO2:PO2: Strongly related by applying systematic approaches to identify, organize, and debug programs, aligning with professional tasks.

CO3:PO2: Strongly related as implementing data structure operations using C++ aligns with industry standards and practical skills.

CO4:PO2: Strongly related by solving problems with appropriate data structures, demonstrating practical application in real-world scenarios.

CO5:PO2: Moderately related by creating web pages, which involves practical skills and knowledge of web development standards.

CO6:PO2: Strongly related by building dynamic web pages using JavaScript, requiring practical programming skills relevant to the industry.

CO7:PO2: Moderately related by building dynamic web pages using Bootstrap, which involves applying practical design principles.

Mapping of PO3 with All CO'S

CO1:PO3: Partially related as understanding data structures provides foundational knowledge, but limited direct application to entrepreneurship.

CO2:PO3: Partially related; systematic problem-solving skills can be beneficial but are not directly focused on entrepreneurship.

CO3:PO3: Partially related as implementing data structures enhances technical skills but doesn't directly cultivate an entrepreneurial mindset.

CO4:PO3: Moderately related by fostering innovative problem-solving skills, which can be useful in entrepreneurial contexts.

CO5:PO3: Strongly related as creating web pages involves design thinking, creativity, and understanding market needs—key for entrepreneurship.

CO6:PO3: Strongly related by building dynamic web pages, encouraging innovation and understanding user experience, important for entrepreneurial projects.

CO7:PO3: Strongly related as using Bootstrap for dynamic web pages fosters an entrepreneurial approach by enhancing user interface design and rapid prototyping.

Mapping of PO4 with All CO'S

CO1:PO4: Strongly related as it involves analytical skills in designing and analyzing the efficiency of data structures.

CO2:PO4: Strongly related by developing technical skills in identifying appropriate data structures and systematic problem-solving.

CO3:PO4: Strongly related as it enhances proficiency in implementing data structures using C++, reflecting technical competencies.

CO4:PO4: Strongly related by applying problem-solving skills to implement appropriate data structures for various scenarios.

CO5:PO4: Moderately related as creating web pages involves technical skills and some level of analytical thinking and design.

CO6:PO4: Strongly related as building dynamic web pages requires technical skills in programming and problem-solving.

CO7:PO4: Moderately related by using Bootstrap to develop dynamic web pages, involving both technical skills and adaptability.

Mapping of PO5 with All CO'S

CO1:PO5: Strongly related as it requires analytical reasoning to design and analyze the efficiency of data structures.

CO2:PO5: Strongly related by applying a systematic approach to solving problems through appropriate data structure selection and debugging.

CO3:PO5: Strongly related as it involves implementing complex data structure operations in C++, requiring practical application and problem-solving.

CO4:PO5: Strongly related by directly focusing on solving complex problems using appropriate data structures.

CO5:PO5: Moderately related as creating web pages involves applying learned concepts, but with less emphasis on complex problem-solving.

CO6:PO5: Strongly related by building dynamic web pages, which involves creativity, adaptability, and applying problem-solving skills.

CO7:PO5: Moderately related as using Bootstrap involves applying knowledge to design web pages, but with a more straightforward problem-solving approach.

Mapping of PO6 with All CO'S

CO1:PO6: Partially related as understanding data structures involves individual learning with limited emphasis on communication and collaboration.

CO2:PO6: Moderately related; organizing and debugging programs may involve collaboration and communication in team settings.

CO3:PO6: Partially related as implementing data structures in C++ is primarily a technical skill with limited direct impact on communication skills.

CO4:PO6: Moderately related since solving problems with appropriate data structures may require teamwork and sharing solutions.

CO5:PO6: Strongly related as creating web pages often involves team collaboration, design discussions, and effective communication.

CO6:PO6: Strongly related by building dynamic web pages using JavaScript, which often requires clear communication and teamwork in development projects.

CO7:PO6: Strongly related as developing dynamic web pages using Bootstrap often necessitates teamwork, collaboration, and effective communication.

Mapping of PO7 with All CO'S

CO1:PO7: Moderately related as analyzing data structures involves inquiry and analytical skills, which can support research activities.

CO2:PO7: Strongly related as systematically identifying data structures and debugging involves a research-oriented approach to problem-solving.

CO3:PO7: Moderately related by implementing data structures, which requires observation, analysis, and testing methodologies, similar to research skills.

CO4:PO7: Strongly related by solving problems using appropriate data structures, which requires formulating questions and analytical thinking akin to research.

CO5:PO7: Partially related; creating web pages involves some research into design principles but is less focused on research methodologies.

CO6:PO7: Moderately related by building dynamic web pages, requiring some research into client-side programming techniques and user experience.

CO7:PO7: Moderately related as using Bootstrap for web development involves research into best practices and responsive design but does not focus on research methodologies.

Mapping of PO8 with All CO'S

CO1:PO8: Strongly related as understanding and analyzing advanced data structures requires continuous learning and adaptation to new concepts.

CO2:PO8: Strongly related by encouraging self-directed learning to identify and apply appropriate data structures and debugging techniques.

CO3:PO8: Strongly related as implementing data structures using C++ requires independently learning coding practices and optimizing solutions.

CO4:PO8: Strongly related as solving complex problems with data structures requires continuous learning and adapting to new challenges.

CO5:PO8: Moderately related by creating web pages using HTML and CSS, which involves learning new design and development trends.

CO6:PO8: Strongly related as building dynamic web pages with JavaScript involves learning evolving technologies and frameworks.

CO7:PO8: Strongly related as building web pages using Bootstrap requires staying updated with the latest features and design practices.

Mapping of PO9 with All CO'S

CO1:PO9: Moderately related as understanding data structures enhances problem-solving skills, but direct ICT and software usage are limited.

CO2:PO9: Moderately related by developing a systematic approach to organizing and debugging programs, which can involve using software tools.

CO3:PO9: Strongly related as implementing data structures using C++ requires proficiency in programming, a key digital skill.

CO4:PO9: Moderately related by solving problems with data structures, potentially involving software tools, but primarily focusing on logic.

CO5:PO9: Strongly related as creating web pages using HTML and CSS involves fundamental digital skills and familiarity with web development tools.

CO6:PO9: Strongly related by building dynamic web pages using JavaScript, which requires digital proficiency in client-side scripting and debugging tools.

CO7:PO9: Strongly related as using Bootstrap for web development requires digital skills in responsive design and effective use of development frameworks.

Mapping of PO10 with All CO'S

CO1:PO10: Partially related as understanding data structures is primarily technical and does not directly address multicultural competence.

CO2:PO10: Partially related; while problem-solving can involve collaboration, it does not inherently focus on multicultural or empathetic engagement.

CO3:PO10: Partially related as implementing data structures in C++ is mainly a technical skill with limited direct impact on multicultural competence.

CO4:PO10: Partially related as solving technical problems is focused on logical skills rather than engaging in multicultural settings.

CO5:PO10: Moderately related as creating web pages may require understanding diverse user needs and perspectives, fostering inclusivity.

CO6:PO10: Moderately related by building dynamic web pages, potentially involving empathy in understanding diverse user experiences and accessibility needs.

CO7:PO10: Moderately related as using Bootstrap to build web pages may involve considering diverse user interfaces and experiences, promoting inclusivity.

Mapping of PO11 with All CO'S

CO1:PO11: Partially related as understanding data structures is focused on technical skills with limited direct impact on ethical or environmental issues.

CO2:PO11: Partially related; identifying and organizing data structures is technical and does not directly involve value inculcation or environmental awareness.

CO3:PO11: Partially related as implementing data structures in C++ is mainly a technical skill with little relevance to ethical values or environmental conservation.

CO4:PO11: Partially related as solving problems with data structures primarily addresses technical challenges rather than ethical or environmental considerations.

CO5:PO11: Moderately related as creating web pages with HTML and CSS may involve considerations of web accessibility and design ethics, though not directly focused on environmental issues.

CO6:PO11: Moderately related; building dynamic web pages with JavaScript can include ethical considerations in user experience design, but is not primarily focused on environmental awareness.

CO7:PO11: Moderately related as using Bootstrap involves design and development practices, which can include considerations for ethical design and accessibility, though not directly linked to environmental awareness.

Mapping of PO12 with All CO'S

CO1:PO12: Moderately related; understanding and analyzing data structures independently involves a degree of autonomy and responsibility in learning.

CO2:PO12: Moderately related as identifying and systematically applying data structures requires independent thinking and problem management.

CO3:PO12: Strongly related by implementing data structures in C++ independently, which requires managing projects and demonstrating accountability for outcomes.

CO4:PO12: Strongly related as solving problems with data structures involves taking responsibility for solutions and managing problem-solving processes.

CO5:PO12: Moderately related as creating web pages involves managing projects independently and demonstrating responsibility for the design and functionality.

CO6:PO12: Strongly related by building dynamic web pages with JavaScript, which requires effective project management, responsibility, and accountability in coding and implementation.

CO7:PO12: Moderately related as using Bootstrap to develop web pages involves managing design projects and taking responsibility for the final output.

Mapping of PO13 with All CO'S

CO1:PO13: Partially related as understanding data structures is primarily technical, with limited direct impact on community engagement.

CO2:PO13: Partially related; identifying and organizing data structures is technical and does not directly involve community service or engagement

CO3:PO13: Partially related as implementing data structures in C++ is technical and does not inherently involve community-focused activities.

CO4:PO13: Partially related as solving problems with data structures mainly addresses technical challenges without a direct community engagement component.

CO5:PO13: Moderately related as creating web pages with HTML and CSS could be part of community-oriented projects or services, though not inherently focused on community engagement.

CO6:PO13: Moderately related; building dynamic web pages with JavaScript may support community-focused applications but is not directly linked to community service.

CO7:PO13: Moderately related as using Bootstrap to develop web pages can be part of community engagement projects, though it is not specifically targeted at societal well-being.

SYLLABUS (CBCS as per NEP2020) FOR S.Y.B.Sc.(Computer Science) Sem-IV

(w. e. from A.Y. 2025-26)

Name of the Programme :B.Sc. Computer Science

Program Code : USCOS

Class : S.Y.B.Sc.(Computer Science)

Semester : IV

Course Type : Vocational Skill Course (VSC)

Course Name : Core Java (TH)

Course Code : COS-254-VSC

No. of Lectures : 30

No. of Credits : 02

Prerequisites:

- Basic knowledge of programming languages like C, CPP.
- Knowledge of Object-Oriented Concepts.

Objective:

1. To learn Object Oriented Programming language
2. To Read Input from users by different ways
3. To Define classes with different access modifiers
4. To handle complex problems using object oriented concepts
5. To handle abnormal termination of a program using exception handling
6. To handle string using String& String Buffer Class
7. To understand file handling using java

Course Outcome:

CO1.Understand Object Oriented Concepts

CO2.Read input from different ways.

CO3.Define class with different access modifiers and create object.

CO4.Write implement real world problems using Java

CO5.Handle exceptions during programs

CO6.Handle String efficiently

CO7.Handle file with different modes and formats

Unit	Title and Contents	No. of Lectures
Unit 1	**An Introduction & Overview to Java** 1.1 A Short History of Java 1.2 Features or buzzwords of Java 1.3 Comparison of Java and C++ 1.4 Java Environment 1.5 Simple java program 1.6 Java Tools – jdb ,javap, javadoc 1.7 Java IDE–Eclipse/ NetBeans (Note: Only for Lab Demonstration) 1.8 Types of Comments 1.9 Data Types 1.10 Final Variable 1.11 Declaring1D,2Darray 1.12 Input Accepting Method (Command line argument, console using Buffered Reader class, Scanner class)	**8**

Unit 2	**Objects and Classes** 2.1Defining Your Own Classes 2.2 Static block, Static Fields and methods 2.3 Pre defined class–Object class methods (equals(), toString(), hash code(), getClass()) 2.4 Creating, Accessing and using Packages 2.5 Wrapper Classes 2.6 Garbage Collection(finalize()Method)	**3**
Unit 3	**Inheritance and Interface** 3.1 Inheritance Basics (extends Keyword) and Types of Inheritance 3.2 Super class, Sub class and use of Super Keyword 3.3 Method Overriding and runtime polymorphism 3.4 Use of final keyword related to method and class 3.5 Use of abstract class and abstract methods 3.6 Defining and Implementing Interfaces 3.7 Runtime polymorphism using interface 3.8 Object Cloning	**8**
Unit 4	**Exception Handling** 4.1 Dealing Errors 4.2 Exception class, Checked and Unchecked exception 4.3 Catching exception and exception handling 4.4 Creating user defined exception 4.5 Assertions	**3**
Unit 5	**Strings , Streams and Files** 5.1 String class and String Buffer Class 5.2 Formatting string data using format() method 5.3 Using the File class 5.4 Stream classes Byte Stream classes Character Stream Classes 5.5 Creation of files 5.6 Reading/ Writing characters and bytes 5.7 Handling primitive data types 5.8 Random Access files	**8**

References: 1) Complete reference Java by Herbert Schildt (5thedition)

2) Java2 programming black books, StevenHorlzner

3) Programming with Java, A primer, Forth edition, By E. Balagurusamy

4) CoreJavaVolume-I-Fundamentals, EighthEdition, CayS. Horstmann, GaryCornell, Prentice Hall, Sun Microsystems Press

Course Outcomes	**Programme Outcomes(POs)**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	2	3	3	2	2	3	3	2	2	3	2
CO2	3	3	2	3	3	2	2	3	3	2	2	3	2
CO3	3	3	1	2	3	1	1	2	2	1	1	2	1
CO4	3	3	1	2	2	1	1	2	2	1	1	2	1
CO5	3	3	1	2	2	1	1	2	2	1	1	2	1
CO6	2	2	1	2	2	1	1	2	1	1	1	2	1
CO7	3	3	2	3	3	2	2	3	3	2	2	3	2

Weight: 1 - Partially related 2 - Moderately Related 3-

Stronglyrelated Mapping of CO WITH PO

CO1WithPO1: As proficiency in using data structures demonstrates a profound understanding of foundational theories and principles within the field of study, essential for problem-solving in a multidisciplinary context.

CO2WithPO1: As the ability to differentiate between different data structures and their appropriate usage showcases a deep understanding of methodologies and key concepts, contributing to a broader multidisciplinary perspective.

CO3 With PO1 : As understanding discrete structures is foundational to grasping the theoretical underpinnings of computer science, enhancing knowledge within a broader multidisciplinary context.

CO4 With PO1 : As studying propositional logic and Boolean algebra provides a theoretical framework that is crucial for understanding foundational theories and principles within the field of study, contributing to a broader multidisciplinary perspective.

CO5 With PO1 : As the ability to analyze proof techniques demonstrates proficiency in applying methodologies and key concepts within the field of study, essential for understanding foundational theories and principles in a broader multidisciplinary context.

CO6 With PO1: As understanding memory allocation contributes to a practical understanding of computer science concepts, although it may be less directly related to multidisciplinary contexts covered in PO1.

CO7 With PO1 : As the ability to efficiently implement data structures demonstrates practical application of foundational theories and principles, essential for problem-solving within a broader multidisciplinary context.

CO1 With PO2: As practical skills in utilizing data structures are essential for professional tasks in problem-solving within real-world scenarios, aligning with industry standards and best practices.

CO2 With PO2 : As the ability to differentiate between different data structures and select the appropriate one for problem-solving reflects expertise and practical skills needed in professional tasks, adhering to industry standards and best practices.

CO3 With PO2: As understanding discrete structures is fundamental for applying knowledge in real- world scenarios, ensuring adherence to industry standards and best practices in problem-solving tasks.

CO4 With PO2 : As studying propositional logic and Boolean algebra provides a theoretical foundation essential for understanding industry standards, regulations, and ethical considerations in real-world scenarios.

CO5 With PO2: As the ability to analyze proof techniques enhances problem-solving skills in professional tasks, aligning with industry standards and best practices.

CO6 WithPO2: As understanding memory allocation is practical knowledge applicable to professional tasks, although it may be less directly related to industry standards and regulations.

CO7WithPO2: As the ability to efficiently implement data structures demonstrates practical expertise essential for professional tasks, aligning with industry standards and best practices.

CO1 With PO3: As the ability to use data structures can contribute to problem-solving skills, which are import an in identifying opportunities and fostering innovation, although it may not directly address business principles, market dynamics, and risk management strategies.

CO2 WithPO3: As the ability to differentiate between different data structures can enhance problem-

solving abilities, which can indirectly contribute to fostering innovation and understanding market dynamics.

CO3 WithPO3: As understanding discrete structures may have limited direct relevance to cultivating an entrepreneurial mind-set and understanding business principles, market dynamics, and risk management strategies.

CO4 With PO3: As studying propositional logic and Boolean algebra may have limited direct relevance to entrepreneurial mind- set or business principles, although it may in directly enhance analytical skills important for risk management.

CO5WithPO3: As studying proof techniques may have limited direct relevance to entrepreneurship or business principles, although it may indirectly enhance critical thinking skills important for identifying opportunities and fostering innovation.

CO6 With PO3 : As understanding memory allocation may have limited direct relevance to entrepreneurial mindset or business principles, although it may indirectly contribute to problem-solving abilities.

CO7 With PO3 : As the ability to efficiently implement data structures can contribute to problem- solving s kills, which are important in identifying opportunities and fostering innovation, although it may not directly address business principles, market dynamics, and risk management strategies.

CO1 With PO4 : As proficiency in utilizing data structures demonstrates technical skills, analytical abilities, and problem-solving capabilities, essential for adapting and innovating in response to changing circumstances.

CO2With PO4: As the ability to differentiate between different data structures show cases analytical abilities and problem-solving skills, crucial for adapting and innovating in response to changing circumstances.

CO3 With PO4 : As understanding discrete structures enhances analytical abilities and problem-solving skills, although its direct impact on technical proficiency and effective communication maybe limited.

CO4With PO4: As studying propositional logic and Boolean algebra develops analytical abilities and problem-solving skills, although its direct impact on technical proficiency and effective communication may be limited.

CO5 With PO4 : As analyzing proof techniques enhances analytical abilities and problem-solving skills, although its direct impact on technical proficiency and effective communication may be limited.

CO6 With PO4 : As understanding memory allocation contributes to technical proficiency and problem-solving skills, although its direct impact on effective communication and leadership may be limited.

CO7 With PO4: As efficiently implementing data structures demonstrates technical proficiency, problem-solving abilities, and leadership qualities, crucial for adapting and innovating in response to changing circumstances.

CO1 With PO5: As the ability to use data structures effectively in problem-solving requires critical thinking, creativity, adaptability, and readiness to learn, essential for applying learned concepts in practical settings and solving complex problems.

CO2 With PO5: As the ability to differentiate between different data structures demonstrates critical thinking and adaptability, crucial for analyzing data effectively and solving complex problems in practical settings.

CO3 With PO5: As understanding discrete structures enhances critical thinking and problem-solving abilities, essential for analyzing data effectively and solving complex problems in practical settings.

CO4 With PO5 : As studying propositional logic and Boolean algebra develops analytical skills and critical thinking, although its direct impact on creativity, adaptability, and readiness to take calculated risks may be limited.

CO5 With PO5: As analyzing proof techniques requires critical thinking and creativity, essential for solving complex problems and taking calculated risks in practical settings.

CO6 With PO5: As understanding memory allocation contributes to problem-solving abilities, although its direct impact on critical thinking and adaptability may be limited.

CO7 With PO5 : As efficiently implementing data structures requires critical thinking, creativity, adaptability, and areadiness to learn,essentail for applying learned conceptsin practicalsettingsand solving complex problems.

CO1 With PO6 : As effectively communicating complex information and collaborating in diverse teams may require the ability to articulate the usage of data structures in problem- solving, but it may not directly address communication skills or teamwork.

CO2 With PO6: As the ability to differentiate between different data structures may indirectly contribute to effective communication and collaboration by facilitating clear explanations and discussions within teams.

CO3 With PO6: As understanding discrete structures may not directly address communication skills or teamwork but may indirectly contribute to problem-solving abilities within teams.

CO4 With PO6: As studying propositional logic and Boolean algebra may enhance analytical skills but may not directly contribute to effective communication or teamwork.

CO5 With PO6: As studying proof techniques may improve critical thinking skills but may not directly address communication skills or teamwork.

CO6 With PO6: As understanding memory allocation may not directly contribute to communication skills or teamwork but may indirectly support problem-solving abilities within teams.

CO7 With PO6 : As efficiently implementing data structures may indirectly support effective communication and collaboration by ensuring that team members understand and utilize appropriate structures in problem-solving tasks.

CO1 With PO7: As the ability to use data structures effectively may indirectly support observational and inquiry skills by providing a structured approach to problem-solving, although it may not directly address research methodologies or ethics.

CO2 With PO7 :as the ability to differentiate between different data structures may indirectly contribute to observational and inquiry skills by fostering critical thinking and analytical abilities, although it may not directly address research methodologies or ethics.

CO3 With PO7: As understanding discrete structures may enhance analytical skills but may not directly contribute to observational and inquiry skills, research methodologies, or ethics.

CO4 With PO7: As studying propositional logic and Boolean algebra may improve analytical skills but may not directly address observational and inquiry skills, research methodologies, or ethics.

CO5 With PO7: As studying proof techniques may enhance critical thinking skills but may not directly contribute to observational and inquiry skills, research methodologies, or ethics.

CO6WithPO7: As understanding memory allocation may support problem-solving abilities but may not directly address observational and inquiry skills, research methodologies, or ethics.

CO7WithPO7: As efficiently implementing data structures may indirectly support observational and inquiry skills by providing practical experience with structured problem-solving, although it may not directly address research methodologies or ethics.

CO1 With PO8: As the ability to utilize data structures effectively demonstrates self-directed learning by acquiring new knowledge and skills, adapting to changing demands, and setting and achieving goals independently through problem-solving.

CO2WithPO8:as the ability to differentiate between different data structures reflects self-

directed learning by acquiring a deeper understanding of their functionalities, adapting to changing demands, and setting and achieving goals independently in problem-solving tasks.

CO3WithPO8:as understanding discrete structures enhances problem-solving abilities and reflects self-directed learning, although its direct impact on adaptability to changing demands and goal achievement may be limited.

CO4 With PO8 : As studying propositional logic and Boolean algebra enhances analytical skills and reflects self-directed learning, although its direct impact on adaptability and goal achievement may be limited.

CO5 With PO8: As analyzing proof techniques develops critical thinking skills and reflects self-directed learning, although its direct impact on adaptability and goal achievement may be limited.

CO6 With PO8: As understanding memory allocation contributes to problem-solving abilities and reflects self-directed learning, although its direct impact on adaptability and goal achievement maybe limited.

CO7 With PO8: As efficiently implementing data structures demonstrates self-directed learning by acquiring practical skills, adapting to changing demands, and setting and achieving goals independently in problem-solving tasks.

CO1 With PO9: As proficiency in using data structures is essential for effectively organizing and analyzing data using appropriate software, aligning with the demonstration of proficiency in ICT and data analysis.

CO2WithPO9:as the ability to differentiate between different data structures reflects proficiency in understanding and utilizing appropriate software for data analysis, accessing information sources, and utilizing ICT effectively.

CO3 With PO9:as understanding discrete structures contributes to analytical skills, although its direct impact on using ICT and accessing information sources may be limited.

CO4 With PO9:as studying logic and algebra enhances analytical abilities, although its direct impact on using ICT and accessing information sources may be limited.

CO5 With PO9:as analyzing proof techniques enhances critical thinking skills, although its direct impact on using ICT and accessing information sources may be limited.

CO6WithPO9:as understanding memory allocation contributes to technical skills but may have limited direct relevance to using ICT and accessing information sources.

CO7WithPO9:as efficiently implementing data structures demonstrates proficiency in utilizing appropriate software for data analysis, accessing information sources, and using ICT effectively.

CO1 With PO10:as the ability to utilize data structures effectively may indirectly contribute to engaging effectively in multicultural settings by fostering problem-solving skills and analytical thinking, although its direct impact on leading diverse teams and demonstrating empathy maybe limited.

CO2 WithPO10 :as the ability to differentiate between different data structures may indirectly support engaging effectively in multicultural settings by promoting critical thinking and adaptability, although its direct impact on leading diverse teams and demonstrating empathy may be limited.

CO3WithPO10:as understanding discrete structures may enhance analytical skills but may not directly address engagement in multicultural settings or leading diverse teams.

CO4WithPO10:as studying logic and algebra may improve analytical skills but may not directly contribute to engaging in multicultural settings or leading diverse teams.

CO5WithPO10:as analyzing proof techniques may enhance critical thinking skills but may not directly address engagement in multicultural settings or leading diverse teams.

CO6WithPO10:as understanding memory allocation contributes to technical skills but may not directly impact engagement in multicultural settings or leading diverse teams.

CO7 With PO10:as efficiently implementing data structures may indirectly support engagement in multicultural settings by fostering problem-solving skills and adaptability, although its direct impact on leading diverse teams and demonstrating empathy may be limited.

CO1 With PO11:as the ability to use data structures effectively may indirectly contribute to addressing ethical issues by promoting structured problem-solving and decision-making, although its direct impact on embracing ethical values and promoting sustainability may be limited.

CO2WithPO11:as the ability to differentiate between different data structures may indirectly support recognizing and addressing ethical issues by enhancing analytical skills and critical thinking, although its direct impact on ethical values and environmental conservation may be limited.

CO3WithPO11:as understanding discrete structures may enhance problem-solving abilities but may not directly address ethical values or environmental conservation.

CO4WithPO11:as studying logic and algebra may improve analytical skills but may not directly contribute to embracing ethical values or promoting sustainability.

CO5WithPO11:as analyzing proof techniques may enhance critical thinking skills but may not directly address ethical values or environmental conservation.

CO6WithPO11:as understanding memory allocation contributes to technical skills but may not directly impact ethical values or environmental conservation.

CO7 With PO11:as efficiently implementing data structures may indirectly support responsible citizen ship by promoting effective use of resources and decision-making, although its direct impact on ethical values and environmental conservation may be limited.

CO1 With PO12:as the ability to use data structures effectively is essential for independent application of knowledge and skills, effective project management, and demonstrating responsibility and accountability in work and learning contexts.

CO2WithPO12:as the ability to differentiate between different data structures reflects analytical skills and contributes to effective project management and responsibility in work contexts.

CO3WithPO12:as understanding discrete structures enhances problem-solving abilities, which are crucial for managing projects effectively and demonstrating accountability in work contexts.

CO4WithPO12:as studying logic and algebra enhances analytical skills, which are important for independent application of knowledge and skills and effective project management.

CO5 With PO12:as analyzing proof techniques fosters critical thinking and problem-solving abilities, which are relevant for managing projects effectively and demonstrating responsibility in work contexts.

CO6 With PO12:as understanding memory allocation contributes to technical skills necessary for independent application of knowledge and skills and effective project management.

CO7With PO12:as efficiently implementing data structures demonstrates proficiency in applying knowledge and skills independently, managing projects effectively, and showing responsibility and accountability in work and learning contexts.

CO1 With PO13:as the ability to use data structures effectively can indirectly support community-engaged services by facilitating problem-solving skills, although its direct impact on promoting societal well-being may be limited.

CO2 With PO13:as the ability to differentiate between different data structures reflects analytical skills, which can indirectly contribute to community-engaged services by fostering critical thinking, although its direct impact on promoting societal well-being may be limited.

CO3 With PO13:as understanding discrete structures may enhance problem-solving abilities but may not directly contribute to community-engaged services or promoting societal well-being.

CO4 With PO13:as studying logic and algebra enhances analytical skills but may not directly impact community-engaged services or societal well-being.

CO5 With PO13:as analyzing proof techniques fosters critical thinking skills but may not directly contribute to community-engaged services or promoting societal well-being.

CO6 With PO13:as understanding memory allocation contributes to technical skills but may not directly impact community-engaged services or societal well-being.

CO7 With PO13:as efficiently implementing data structures demonstrates proficiency in problem-solving, which can indirectly support community-engaged services by facilitating effective solutions, although its direct impact on promoting societal well-being may be limited

SYLLABUS (CBCS as per NEP 2020) FOR S. Y. B. Sc. (Computer Science) Sem-IV

(w. e. from A.Y. 2025-26)

Name of the Programme: B.Sc. Computer Science

Program Code **:** PSCOS

Class **:** Arts and Commerce Faculty

Semester IV

Course Type **:** Open Elective (PR)

Course Name **:** Basic Tools of Digital Marketing

Course Code **:** COS-258-OE

No. of practicals : 12

No. of Credits : 2

Course Objectives:

1. To understand the basic knowledge of Digital Marketing
2. To understand the Social Media Marketing.
3. To create a digital marketing posters with help of Canva.
4. To generate an average report based on the Digital Marketing.
5. To understand the how to reach customers.

Course outcomes:

CO1-Demonstrate the Canva application for designing posters.

CO2-Demonstrate of Google Analytics.

CO3-Identify and utilize various tools such as social media etc.

CO4-Understand how to create and run digital media-based campaigns

CO5-Articulate innovative insights of digital marketing enabling a competitive edge.

CO6-Understand the concept of digital marketing and its real-world iterations

CO7-Explain the key digital marketing activities needed for competitive success

Sr. no.	Title of Experiment/ Practical	No. of Lectures
Unit 1	**Fundamentals Digital Marketing** • Introduction of Digital Marketing, • Social Media Platforms, • Search Engine Optimization. • Search Engine Marketing (SEM)	**08**
Unit 2	**Design Essentials** • Canva application (Using related Various application) • Poster Design	**08**
Unit 3	**Social Media Digital Marketing** • Facebook Marketing • Instagram Marketing • YouTube Marketing • E-Mail Marketing	**08**

Unit 4	**Content Marketing** • Developing a content strategy • creating blog posts, videos, and other content	06

Mapping of this course with Programme Outcomes

Course Outcomes	Programmed Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	2	3	2	3	2	2	3	2	3	2	1	2	3
CO2	3	3	2	3	3	2	3	3	3	2	2	2	3
CO3	3	3	2	3	3	2	3	3	3	2	2	2	3
CO4	3	3	3	3	2	2	3	3	3	2	2	2	3
CO5	3	3	2	3	3	2	2	3	3	2	2	2	3
CO6	3	3	2	3	3	2	3	3	3	2	2	2	3
CO7	3	3	2	3	3	2	3	3	3	2	2	2	3

Weight: 1-Partiallyrelated 2 – Moderately Related 3 –Strongly

Related Justification of PO1 to ALL COs:

Canva usage requires basic design principles and knowledge, which contributes to comprehensive learning. Understanding Google Analytics involves strong analytical skills, supporting comprehensive knowledge.

Justification of PO2 to ALL COs:

Mastering Canva is highly practical, offering tangible skills for professional digital design work. Google Analytics is a core tool in digital marketing, essential for analyzing data in a professional setting.

Justification of PO3 to ALL COs:

Proficiency in social media tools is a crucial part of professional and procedural knowledge in marketing. Practical understanding of running campaigns directly relates to professional marketing practices.

Justification of PO4 to ALL COs:

Though innovation is important, it is less procedural and more strategic in nature. Real-world application of digital marketing concepts is highly relevant to procedural and professional skills

Justification of PO5 to ALL COs:

Canva helps in applying design knowledge, but the problem-solving aspect is limited to creative challenges. Identifying appropriate tools involves critical application and problem-solving based on marketing needs.

Justification of PO6 to ALL COs:

Identifying appropriate tools involves critical application and problem-solving based on marketing needs. Innovation in marketing directly involves applying insights to solve competitive challenges. **Justification of PO7 to ALL COs:**

Knowledge of core activities is crucial for solving business problems and achieving success. Understanding real-world applications is vital for problem-solving and the practical application of concepts.

Justification of PO8 to ALL COs:

Learning Canva involves self-directed learning and mastering new tools, but is somewhat limited to design. Google Analytics requires continual learning and adapting to new data-driven insights,

fostering analytical learning.

Justification of PO9 to ALL COs:

Exploring and adapting to a variety of social media tools fosters independent learning and flexibility. Running campaigns involves experiential learning and problem-solving, which builds adaptive learning skills.

Justification of PO10 to ALL COs:

Innovation requires an open mindset and learning from new trends and competitive landscapes. Learning to apply core digital marketing concepts in real-world scenarios fosters continuous learning.

Justification of PO11 to ALL COs:

While useful for business, Google Analytics does not directly engage with value inculcation or environmental awareness. Social media platforms can be used to promote values and environmental causes, depending on the campaigns designed

Justification of PO12 to ALL COs:

Innovative strategies can incorporate value-driven elements like social responsibility or sustainability. Digital marketing concepts can include sustainable and ethical marketing practices, fostering awareness.

Justification of PO13 to ALL COs:

Focuses on competitive success but doesn't inherently include value inculcation or environmental awareness.

SYLLABUS (CBCS as per NEP 2020) FOR S. Y. B. Sc. (Computer Science) Sem-IV

(w. e. from June, 2024)

Name of the Programme: B.Sc. Computer Science
Program Code : USCOS
Class **:** S.Y.B.Sc. (Computer Science)
Semester IV
Course Type **:** Skill Enhancement
Course Name **:** Lab Course Based on COS-254-VSC
Course Code **:** COS-259-SEC
No. of Lectures 30
No. of Credits **02**

Course Objectives:

1. To learn Object Oriented Programming language.
2. To Read Input from users by different ways.
3. To define classes with different access modifiers.
4. To handle complex problems using object-oriented concepts.
5. To handle abnormal termination of a program using exception handling.
6. To handle string using String &String Buffer Class.
7. To understand file handling using java.

Course Outcomes: On completion of the course, student will be able to
CO1. Understand Object Oriented Concepts
CO2. Understand the difference between Java & CPP
CO3. Read input from different ways.
CO4. Define class with different access modifiers and create object.
CO5. Write real world problems using Java
CO6. Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming.
CO7. Demonstrate the use of various OOPs concepts with the help of programs.

Sr. No	Assignment Name	No. of Practicals
1	Java Tools	**1**
2	Array of Objects	**2**
3	Packages	**2**
4	Single Inheritance	**1**
5	Multilevel Inheritance	**1**
6	Interfaces	**2**
7	Exception Handling and Assertions	**2**
8	Input Output	**2**
9	File Handling	**2**

References:

1) Complete reference Java by Herbert Schildt (5th edition)

2) Java 2 programming black books, Steven Horlzner

3) Programming with Java , A primer ,Forth edition , By E. Balagurusamy

4) Core Java Volume-I-Fundamentals, Eighth Edition, Cay S. Horstmann, Gary Cornell, Prentice Hall, Sun Microsystems Press

Mapping of this course with Programme Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	-	1	2	-	-	2	2	-	-	-	-
CO2	3	2	-	1	2	-	-	2	2	-	-	-	-
CO3	2	3	-	1	3	-	-	2	3	-	-	-	-
CO4	3	3	-	2	3	-	-	2	3	-	-	-	-
CO5	3	3	2	3	3	2	-	2	3	1	1	2	2
CO6	3	3	2	3	3	1	-	3	3	-	-	2	-
CO7	3	3	2	3	3	2	1	3	3	1	1	2	2

Weight: 1 - Partially related 2 - Moderately related 3-Strongly related

Mapping of PO1 With All CO's with Justification:

CO1: With PO1: Builds comprehensive understanding of OOP principles — classes, objects, encapsulation, and polymorphism.
CO2: With PO1: Deepens conceptual knowledge of two OOP languages and their core differences.
CO3: With PO1: Provides foundational knowledge of Java I/O mechanisms.
CO4: With PO1: Reinforces theoretical understanding of encapsulation and data hiding.
CO5: With PO1: Applies theoretical understanding to real-world systems.
CO6: WithPO1: Expands conceptual understanding of advanced OOP mechanisms.
CO7: With PO1 : Integrates full conceptual understanding of OOP principles.

Mapping of PO2 With All CO's with Justification:

CO1: WithPO2 : Students apply basic OOP knowledge in lab programs.
CO2: WithPO2 : Builds procedural understanding through syntax and memory management comparison.
CO3: With PO2 : Strongly develops procedural coding skills using Scanner, Buffered Reader, and Console.
CO4: With PO2 : Practical skill-building through class and object creation.
CO5: WithPO2 : Enhances practical programming proficiency.
CO6: With PO2 Strengthens procedural coding with inheritance and generics.
CO7: With PO2 : Encourages practical and procedural expertise through coding assignments.

Mapping of PO3 With All CO's with Justification:

CO5: With PO3: Encourages creativity and innovation in designing problem solutions.
CO6: WithPO3 : Encourages analytical and innovative thinking in class hierarchies.
CO7: WithPO3 : Promotes innovation through creative problem-solving.

Mapping of PO4 With All CO's with Justification:

CO1: With PO4 : Begins developing specialized skills in design thinking.
CO2: WithPO4 : Improves technical adaptability.
CO3: WithPO4 : Introduces specific skill in data handling.
CO4: With PO4: Specialized coding and design skill.
CO5: With PO4: Builds specialized software development skills.
CO6: WithPO4 : Builds proficiency in advanced Java concepts.
CO7: With PO4: Strengthens technical and analytical competencies.

Mapping of PO5 With All CO's with Justification:

CO1: WithPO5: Enhances analytical reasoning for object-oriented problem structuring.
CO2: WithPO5: Strengthens analytical thinking about language choice.
CO3: With PO5: Builds problem-solving abilities in handling user inputs.
CO4: With PO5: Strong alignment with solving real programming tasks.
CO5: WithPO5: Directly related to problem-solving and analytical reasoning.
CO6:WithPO5: Promotes analytical reasoning through debugging and handling exceptions.
CO7: WithPO5 : Applies all learned concepts for effective problem-solving.

Mapping of PO6 With All CO's with Justification:

CO5: With PO6: Improves teamwork and communication in project discussions.
CO6: With PO6 : Fosters communication while discussing program logic.
CO7: WithPO6 : Enhances collaboration and communication through teamwork and presentations.

Mapping of PO7 With All CO's with Justification:

CO7: With PO7: Encourages research-like exploration in program enhancement.

Mapping of PO8 With All CO's with Justification:

CO1: With PO8 : Encourages independent conceptual learning.
CO2: WithPO8 : Promotes self-learning to explore language features.
CO3: WithPO8 : Promotes learning adaptability to multiple input methods.
CO4: WithPO8 : Encourages continued learning by implementing varied access levels.
CO5: WithPO8 : Strengthens self-learning and application skills.
CO6: With PO8 : Supports lifelong learning of complex Java topics.
CO7: With PO8: Builds self-learning habits through project implementation.

Mapping of PO9 With All CO's with Justification:

CO1: With PO9 : Relates to understanding software development environments.
CO2: WithPO9 : Supports digital literacy through compiler and runtime environment use.
CO3: WithPO9 : Strongly enhances technological proficiency in data input/output operations.
CO4: WithPO9 : Strengthens ICT and programming environment usage.
CO5: WithPO9 : Utilizes digital tools for programming and debugging.
CO6: With PO9 : Strengthens digital proficiency via IDEs and Java frameworks.
CO7: With PO9: Improves digital and programming tool proficiency.

Mapping of PO10 With All CO's with Justification:

Mapping of PO11 With All CO's with Justification:

CO5: WithPO11: Introduces ethics in programming (code quality, plagiarism).

CO7: With PO11: Instills ethical awareness in coding practices.

Mapping of PO12 With All CO's with Justification:

CO5: With PO12: Promotes responsibility and accountability in project execution.

CO6: With PO12: Promotes accountability for code accuracy.

CO7: With PO12: Encourages autonomy and accountability in programming.

Mapping of PO13 With All CO's with Justification:

CO5: WithPO13: Fosters social awareness through problem-based applications.

CO7: With PO13: Promotes community-oriented applications and service ideas.

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Examination Pattern / Evaluation Pattern

Teaching and Evaluation (for Major, Minor, AEC, VEC, IKS courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	4 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Teaching and Evaluation (for VSC, SEC & CC courses)

- Evaluation to be done by Internal & External Experts
- No descriptive end semester written examination
- Evaluation to be done at Department level preferably prior to commencement of Theory /Practical Examinations
- Evaluation to be done on the Skills gained by student