



Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science & Commerce,
Baramati
(Empowered Autonomous)

Three/Four Year Honours/Honours with Research BCA Degree
Program in BCA
(Faculty of Commerce and Management)

CBCS Syllabus
SYBCA, Sem.-IV
For Department of Computer Application (BCA)

NEP-2.0
Choice Based Credit System Syllabus
(2024 Pattern)
(As Per NEP-2020)

To be Implemented from Academic Year 2025-2026

Title of the Programme: SYBCA

Preamble

AES's Tuljaram Chaturchand College has decided to change the syllabus of various faculties from June, 2023 by taking into consideration the guidelines and provisions given 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 outcomes for the development of the students. The credit structure and the courses framework provided in the NEP are nationally accepted and internationally comparable.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Computer Science and related subjects, Board of Studies in BCA of Tuljaram Chaturchand College, Baramati - Pune has prepared the syllabus of SYBCA Semester - III under the Choice Based Credit System (CBCS) by following the guidelines of NEP 2020, NCeF, NHEQF, Prof. R.D. Kulkarni's Report, GR of Gov. of Maharashtra dated 20th April, 16th May 2023 and 13th March, 2024 and Circular of SPPU, Pune dated 31st May 2023 and 2nd May, 2024.

BCA is Undergraduate Degree Program with Computer Applications. This program provides sound knowledge of theory and practical's. The different subjects helps the students to design, develop and implement software Applications, to learn emerging computer technologies and produce skilled human resource to face the professional challenges.

Overall, revising the BCA 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 Outcome for NEP 2020
(With Effect from June 2025-26)
Commerce and Management (Under Graduate Programme)**

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)

- PSO1. Knowledge:** To understand and apply the fundamental principles, concepts, and methods in diverse areas of computer science, computer applications, mathematics, statistics, etc.
- PSO2. Problem Analysis:** Identify, analyze and formulate complex real-life computing problems. Attain substantiated conclusions to solve the problems using fundamental principles of computer science and application domains by using various tools and emerging technologies.
- PSO3. Design and Development:** Design and develop efficient solutions for complex real-world computing problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and the cultural, societal, and environmental considerations.
- PSO4. Conduct investigations of complex problems:** Ability to research, analyze and Investigate complex computing problems through the design of experiments, analysis, and interpretation of data, and synthesis of the information to arrive at valid conclusions.
- PSO5. Modern Tool Usage:** Create, identify and apply appropriate techniques, skills, and modern computing tools to computing activities.
- PSO6. Ethics and Social Responsibility:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
- PSO7. Individual and Team Work:** Ability to work effectively as an individual, and as a member or leader as per need in, multidisciplinary teams.
- PSO8. Life-Long Learning:** Recognize the need and have the ability to engage in Independent continuous reflective learning in the context of technological advancement.
- PSO9. Project Management:** Understand and apply computing, management principles to manage projects.
- PSO10. Communication:** Able to use interpersonal skills and communicate effectively with the professionals and with society to convey technical information effectively and accurately and able to comprehend and write effective reports, design documentation, and make effective presentations.
- PSO11. Innovation, employability, and Entrepreneurial skills:** Identify opportunities, and pursue those opportunities to create value and wealth for the betterment of the individual and society at large.

Anekant Education Society's
Tuljaram Chaturchand College, Baramati
(Empowered Autonomous)

Board of Studies in B.C.A.

(Academic Year 2025-26 to 2027-28)

Sr. No.	Name of Member	Designation
1.	Mr. Shah Vishal V.	Chairperson
2.	Mr. Shah Rahul A.	Member
3.	Ms. Kulkarni Prajakta P.	Member
4.	Mrs. Bhagat Asmita A.	Member
5.	Ms. Londhe Kalyani W.	Member
6.	Mrs. Swami Poornima C.	Member
7.	Mr. Chemte Swapnil P.	Member
8.	Ms. Saste Madhuri R.	Member
9.	Dr. Ponde Poonam	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
10.	Dr. Dongardive Jyotshna	Subject Expert from Outside the Parent University
11.	Dr. Magre Ritesh	Subject Expert from Outside the Parent University
12.	Mr. Jain Abhishek	Representative from industry/corporate sector/allied areas
13.	Ms. Naziya Attar	Invited –Member
14.	Ms. Tanuja Giramkar	Invited –Member
15.	-	Member of the College Alumni
16.	Mr. Mane Sandip M.	UG Student
17.	-	PG Student

Credit distribution Structure of B.C.A. (2024 Pattern)

Level	Sem.	Core Courses				Minor	GE/OE	AEC	IKS Gen.	VEC	SEC	CC	Total
4.5	I	6(T)+6(P)				-	2 (T)	2(T)	2(T)	2(T)	2(P)	-	22
	II	6(T)+6(P)				-	2 (P)	2(T)	-	2(T)	2(P)	2	22
Exit Option : Award of UG Certificate in Major With Total Credits 44 Continue option: Student will select Computer as major and one as Minor.													
Level	Sem.	Credit Related to Major				Minor	GE/OE	AEC	IKS Gen.	VEC	SEC	CC	Total
		Major Core	Major Elective	VSC	FP/OJT/CEP/RP								
5.0	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)	-	-	2(T/P)	2(T)	22
Exit Option: Award of UG Diploma in Major and Minor With Total Credits 88 OR Continue with Major and Minor.													
5.5	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 3 Years		86				10	08	08	04	04	06	06	132
Exit Option: Award of UG Degree in Major and Minor With Total Credits 132 OR Continue with Major and Minor.													
6.0	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)	-	8(RP)	-	-	-	-	-	-	-	22
Total 4 Years		126				14	08	08	04	04	06	06	176
Four Year UG Honours with Research Degree in Major and Minor with Total credits 176													
6.0	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 4 Years		126				14	08	08	04	04	06	06	176
Four Year UG Honours Degree in Major and Minor with Total credits 176													

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 Structure of F.Y. BCA (2024 Pattern)
(As Per NEP-2020)

FY BCA – Semester –I							
Course Type	Course Code	Paper Title	Hours/Week	Credits	Internal	External	Total
Major Mandatory	BCA-101 GEN	Problem Solving Techniques and Basic C Programming	02 (T)	02	20	30	50
	BCA-102 GEN	Lab Course on BCA-101 GEN	04(P)	02	25	25	50
	BCA-103 GEN	Computer Architecture	02(T)	02	20	30	50
	BCA-104 GEN	Lab Course on BCA-103 GEN	04(P)	02	25	25	50
	BCA-105 GEN	Foundation of Mathematics for Computer Science	02(T)	02	20	30	50
	BCA-106 GEN	Lab Course on BCA-105 GEN	04(P)	02	25	25	50
Open Elective (OE)	BCA-107OE	Business Statistics	02(T)	02	20	30	50
Skill Enhancement Course (SEC)	BCA-101 SEC	HTML & Web Page Designing	04(P)	02	25	25	50
IKS Generic	GEN-106- IKS	Indian Knowledge System	02(T)	02	20	30	50
Ability Enhancement Course (AEC)	ENG-101 AEC	General English – I	02(T)	02	20	30	50
Value Education Course (VEC)	ENV-105 VEC	Environmental Awareness	02(T)	02	20	30	50
Total				22	240	310	550

FY BCA – Semester -II							
Course Type	Course Code	Paper Title	Hours/Week	Credits	Internal	External	Total
Major Mandatory	BCA-151 GEN	Advanced C Programming	02 (T)	02	20	30	50
	BCA-152 GEN	Lab Course on BCA-151 GEN	04(P)	02	25	25	50
	BCA-153 GEN	Introduction to Microcontroller	02(T)	02	20	30	50
	BCA-154 GEN	Lab Course on BCA-153 GEN	04(P)	02	25	25	50
	BCA-155 GEN	Linear Algebra	02(T)	02	20	30	50
	BCA-156 GEN	Lab Course on BCA-155 GEN	04(P)	02	25	25	50
Open Elective (OE)	BCA-157 OE	Database Management System	04(P)	02	25	25	50
Skill Enhancement Course (SEC)	BCA-151 SEC	Software Tools for Business Communication	04(P)	02	25	25	50
Ability Enhancement Course (AEC)	ENG-151 AEC	General English – II	02(T)	02	20	30	50
Value Education Course (VEC)	COS-155 VEC	Digital Technological Solution	02(T)	02	20	30	50
Co-curricular Course (CC)	PES-156 CC	Physical Education	02	02	20	30	50
Total				22	245	305	550

Course Structure of S.Y. BCA (2024 Pattern)
(As Per NEP-2020)

SY BCA – Semester -III				
Course Type	Course Code	Course Title	Theory/ Practical	Credits
Major Mandatory	BCA-201-MRM	Algorithms & Data Structures	Theory	02
Major Mandatory	BCA-202-MRM	Database Management Systems	Theory	02
Major Mandatory	BCA-203-MRM	Lab Course based on BCA-201-MRM	Practical	02
Vocational Skill Course (VSC)	BCA-204-VSC	Lab Course based on BCA-202-MRM	Practical	02
Field Project(FP)	BCA-205-FP	Field Project	Practical	02
Minor	BCA-206-MN	Fundamentals of ICT	Theory	02
Minor	BCA-207-MN	Practical Lab on Advanced Excel	Practical	02
Open Elective (OE)	BCA-208-OE	IT in Management	Theory	02
Subject Specific Indian Knowledge System (IKS)	BCA-209-IKS	Ancient Indian Foundations of Computing	Theory	02
Ability Enhancement Course (AEC)	MAR-210-AEC/ HIN-210-AEC/ SAN-210-AEC	Selected from AEC Basket	Theory (Any One)	02
Co-curricular Course (CC)	YOG/PES/CUL/N SS/NCC-211-CC	To be continued from the Semester – II		02
Total Credits of Semester - III				22

SY BCA – Semester –IV				
Course Type	Course Code	Course Title	Theory/ Practical	Credits
Major Mandatory	BCA-251-MRM	Advanced Data Structures	Theory	02
Major Mandatory	BCA-252-MRM	Relational Database Management System	Theory	02
Major Mandatory	BCA-253-MRM	Lab Course based on BCA-251-MRM	Practical	02
Vocational Skill Course (VSC)	BCA-254-VSC	Object Oriented Programming using Java	Theory	02
Community Engagement Project (CEP)	BCA-255-CEP	Community Engagement Project	Practical	02
Minor	BCA-256-MN	Digital Marketing	Theory	02
Minor	BCA-257-MN	Lab Course based on BCA-256-MN	Practical	02
Open Elective (OE)	BCA-258-OE	Machine Learning for Business Administration	Theory	02
Skill Enhancement Course (SEC)	BCA-259-SEC	Lab Course based on BCA-252-MRM	Practical	02
Ability Enhancement Course (AEC)	MAR-260-AEC/ HIN-260-AEC/ SAN-260-AEC	To be continued from the Semester – III	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 of Semester - IV				22
Total Credits Semester – III + IV				44

SEMESTER –IV

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Major Mandatory [Theory]
Course Code	: BCA-251-MRM
Course Title	: Advanced Data Structures
No. of Credits	: 02
No. of Teaching Hours	: 30

Prerequisites:

1. Basic knowledge of algorithms and problem solving.
2. Know arrays, stacks, recursion, searching/sorting and Big-O analysis.

Course Objectives:

1. To understand concepts and operations of advanced data structures.
2. To study queues, trees, graphs, and hash tables in detail.
3. To analyze algorithms using time and space complexity.
4. To implement data structures using recursion and iteration.
5. To develop efficient searching, sorting, and optimization solutions.
6. To enhance logical thinking and problem-solving abilities.
7. To apply data structures in real-world domains like databases, AI, and networking.

Course Outcomes:

By the end of the course, students will be able to:

- CO1:** Demonstrate understanding of advanced data structures and their operations.
- CO2:** Implement queues, trees, graphs, and hash tables using programming.
- CO3:** Analyze algorithms for efficiency in terms of time and space complexity.
- CO4:** Apply recursion and iterative methods to solve data structure problems.
- CO5:** Design efficient solutions for searching, sorting, and optimization tasks.
- CO6:** Develop logical reasoning and problem-solving skills through applications.
- CO7:** Apply advanced data structures to real-world domains such as databases, compilers, AI, and networking.

Topics and Learning Points

Unit	Title and Contents	No. of Lectures
1	Queues 1.1 Linear Queue, Circular Queue, Deque, Priority Queue 1.2 Array and Linked List Implementation 1.3 Applications : Job Scheduling, Buffer Handling	06
2	Trees 2.1 Tree Terminology & Representation 2.2 Binary Trees: Traversals (Inorder, Preorder, Postorder) 2.3 Binary Search Tree (BST): Insertion, Deletion, Searching 2.4 Introduction to AVL Trees 2.5 Applications : Expression Trees, File Systems	08
3	Graph 3.1 Graph Terminology & Representation (Adjacency Matrix/List) 3.2 Graph Traversals: BFS, DFS 3.3 Minimum Spanning Trees (Prim's & Kruskal's Algorithms) 3.4 Applications: Networking, Routing, Social Networks	08
4	Hashing 4.1 Hash Tables & Hash Functions 4.2 Collision Resolution: Chaining, Linear/Quadratic Probing, Double Hashing 4.3 Rehashing, Deletion 4.4 Applications: Symbol Tables, Databases, Caching	08

Reference Books:

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

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	3	2	1	2	2	1	2	2	2	1	1	2	1
CO2	2	3	1	3	3	2	2	3	3	1	1	3	1
CO3	3	2	2	3	3	1	3	3	3	1	2	3	1
CO4	2	3	1	2	3	1	2	2	2	1	1	2	1
CO5	3	3	2	3	3	2	3	3	3	2	2	3	2
CO6	2	2	3	3	3	2	2	3	3	2	2	3	2
CO7	3	3	3	3	3	3	3	3	3	2	2	3	2

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

Justification of Mapping of PO1 with All CO'S

PO1:CO1: Understanding advanced data structures directly contributes to comprehensive knowledge of the field.

PO1:CO2: Implementation involves applying knowledge practically, showing moderate linkage to conceptual understanding.

PO1:CO3: Analyzing algorithm efficiency is a key theoretical aspect that enhances foundational understanding.

PO1:CO4: Application of recursion and iteration builds conceptual clarity but focuses more on practical implementation.

PO1:CO5: Designing efficient solutions requires a strong grasp of theoretical and conceptual knowledge.

PO1:CO6: Logical reasoning and problem-solving show understanding but emphasize skill development.

PO1:CO7: Applying advanced data structures in real-world domains require comprehensive multidisciplinary understanding.

Justification of Mapping of PO2 with All CO'S

PO2:CO1: Understanding operations supports professional application but focuses more on conceptual grasp.

PO2:CO2: involves hands-on programming and application of procedural knowledge.

PO2:CO3: Analytical skills support professional decision making but not direct implementation.

PO2:CO4: Practical skill directly applicable in programming and professional problem solving.

PO2:CO5: Aligns with professional ability to design efficient and optimized solutions.

PO2:CO6: Supports professional competence through skill building, though broader in nature.

PO2:CO7: Direct application of procedural knowledge in professional and real world contexts.

Justification of Mapping of PO3 with All CO'S

PO3:CO1: Foundational understanding supports analytical thinking useful for innovation, but not directly entrepreneurial.

PO3:CO2: Practical coding may assist in building prototypes or technical solutions, but link to entrepreneurship is indirect.

PO3:CO3: Efficiency analysis is vital in developing optimized products or start-ups involving tech solutions.

PO3:CO4: Enhances logical thinking but minimal direct link to entrepreneurship.

PO3:CO5: Solution design aligns with innovative and problem-solving mind-set essential for entrepreneurship.

PO3:CO6: Fosters innovation, creativity, and strategic problem-solving crucial for an entrepreneurial mind-set.

PO3:CO7: Encourages practical innovation and identification of opportunities using advanced technologies.

Justification of Mapping of PO4 with All CO'S

PO4:CO1: Builds analytical understanding and technical foundation for specialized skill development.

PO4:CO2: Enhances hands-on technical proficiency and programming competency.

PO4:CO3: Promotes analytical and problem-solving abilities essential for specialized technical roles.

PO4:CO4: Strengthens logical thinking and structured problem-solving approach.

PO4:CO5: Directly linked to innovation and technical excellence.

PO4:CO6: Core competency for analytical and adaptive professional growth.

PO4:CO7: Integrates domain-specific technical knowledge with real-world application and innovation.

Justification of Mapping of PO5 with All CO'S

PO5:CO1: Understanding structure operations supports analytical reasoning but less direct application.

PO5:CO2: Involves direct application of learned concepts to solve computational problems.

PO5:CO3: Requires analytical reasoning and problem-solving to evaluate performance.

PO5:CO4: Demonstrates practical problem-solving and creative application of logic.

PO5:CO5: Promotes analytical thinking and innovative problem-solving in real-world contexts.

PO5:CO6: Directly builds analytical and reasoning capacity.

PO5:CO7: Integrates applied knowledge with complex real-world problem-solving.

Justification of Mapping of PO6 with All CO'S

PO6:CO1: Understanding supports technical communication, but collaboration aspects are limited.

PO6:CO2: Coding tasks often require teamwork and peer collaboration during implementation.

PO6:CO3: May involve documentation and presentation of analytical results, but not core communication-focused.

PO6:CO4: Primarily technical, with minimal link to communication or teamwork.

PO6:CO5: Designing and presenting optimized solutions requires teamwork and clear explanation.

PO6:CO6: Collaboration and communication often enhance reasoning and group-based problem-solving.

PO6:CO7: Real-world applications typically require teamwork, interdisciplinary communication, and leadership.

Justification of Mapping of PO7 with All CO'S

PO7:CO1: Foundational understanding supports exploring new algorithms and research questions in computing.

PO7:CO2: Practical implementation aids in developing experimental setups for algorithmic research.

PO7:CO3: Directly contributes to research methodologies involving performance evaluation and comparative studies.

PO7:CO4: Useful for experimenting with problem-solving approaches and analyzing results.

PO7:CO5: Fosters innovation, exploration, and formulation of new algorithmic ideas for research.

PO7:CO6: Essential for formulating research hypotheses and drawing analytical conclusions.

PO7:CO7: Involves applying research and innovation to real-world computational domains.

Justification of Mapping of PO8 with All CO'S

PO8:CO1: Understanding complex data structures encourages independent study and conceptual clarity.

PO8:CO2: Involves hands-on, self-driven learning and adapting to coding challenges.

PO8:CO3: Requires independent analytical thinking and continuous improvement through learning.

PO8:CO4: Develops persistence and self-learning in mastering algorithmic techniques.

PO8:CO5: Promotes innovation, exploration, and adaptive learning for better solutions.

PO8:CO6: Strengthens the habit of continuous learning and self-improvement.

PO8:CO7: Involves lifelong learning and adapting to evolving technologies and domains.

Justification of Mapping of PO9 with All CO'S

PO9:CO1: Builds conceptual knowledge essential for understanding digital and computational technologies.

PO9:CO2: Directly involves hands-on programming and use of ICT tools for implementation

PO9:CO3: Applies analytical tools and computational thinking central to digital proficiency.

PO9:CO4: Reinforces computational logic and coding abilities in technological contexts.

PO9:CO5: Requires algorithmic thinking and software-based solution design.

PO9:CO6: Strengthens use of digital tools and computational reasoning for solving problems.

PO9:CO7: Directly applies ICT and technology-driven knowledge to real-world systems.

Justification of Mapping of PO10 with All CO'S

PO10:CO1: Conceptual understanding has minimal connection to teamwork or empathy aspects.

PO10:CO2: Involves collaboration and peer interaction in group programming tasks.

PO10:CO3: Limited but can encourage consideration of user or system diversity in solutions.

PO10:CO4: Technical in nature, minor relevance to multicultural or inclusive skills.

PO10:CO5: Problem-solving in diverse teams can foster inclusivity and respect for different approaches.

PO10:CO6: Collaborative problem-solving promotes empathy and inclusiveness in diverse environments.

PO10:CO7: Applying data structures in global and multicultural technology contexts supports diversity and empathy.

Justification of Mapping of PO11 with All CO'S

PO11:CO1: Basic conceptual knowledge offers limited connection to ethics or environmental awareness.

PO11:CO2: Technical practice can encourage responsible coding and ethical data handling.

PO11:CO3: Efficient algorithms promote sustainable computing through optimized resource use.

PO11:CO4: Technical skill development, with minor indirect contribution to ethical awareness.

PO11:CO5: Designing efficient systems contributes to environmental sustainability through reduced computational waste.

PO11:CO6: Fosters responsible decision-making and ethical problem-solving.

PO11:CO7: Promotes ethical and sustainable application of technology in real-world contexts.

Justification of Mapping of PO12 with All CO'S

PO12:CO1: Conceptual mastery supports independent learning and responsible application.

PO12:CO2: Requires self-directed work, accuracy, and accountability in code development.

PO12:CO3: Fosters independent analysis and responsibility for delivering optimized solutions.

PO12:CO4: Enhances self-reliance in problem-solving and method selection.

PO12:CO5: Demands autonomy in designing and evaluating solutions responsibly.

PO12:CO6: Promotes independent critical thinking and accountable decision-making.

PO12:CO7: Demonstrates independent application of knowledge in complex, real-world contexts.

Justification of Mapping of PO13 with All CO'S

PO13:CO1: Foundational knowledge may indirectly support community-focused technical initiatives.

PO13:CO2: Programming skills could assist in community or social-impact software solutions.

PO13:CO3: Analytical efficiency can benefit projects aimed at social good (e.g., data processing for NGOs).

PO13:CO4: Technical problem solving supports contribution to community-based systems.

PO13:CO5: Optimized solutions can be applied in civic or social applications (e.g., resource allocation systems).

PO13:CO6: Critical thinking fosters innovative approaches to community challenges.

PO13:CO7: Real-world application of DS concepts can extend to social, environmental, or civic data systems.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Major Mandatory [Theory]
Course Code	: BCA-252-MRM
Course Title	: Relational Database Management System
No. of Credits	: 02
No. of Teaching Hours	: 30

Prerequisites:

1. Basic knowledge of DBMS.
2. Elementary Mathematics – Sets, relations, functions, and logic.
3. Basics of Computer Fundamentals (Operating system, file management).

Course Objectives:

1. To learn the basics of RDBMS and its uses.
2. To understand database models, rules, and DBA role.
3. To practice PL/SQL programming with variables and control statements.
4. To use PL/SQL features like exceptions, views, procedures, cursors, and triggers.
5. To study transactions and their ACID properties.
6. To learn methods for concurrency control and handling deadlocks.
7. To understand recovery methods and storage structures in databases.

Course Outcomes:

By the end of the course, students will be able to:

CO1: Explain DBMS and RDBMS with key terms.

CO2: Describe relational models, rules, and DBA duties.

CO3: Write simple PL/SQL programs.

CO4: Use exceptions, views, functions, cursors, and triggers in PL/SQL.

CO5: Explain transactions and check if schedules follow ACID rules.

CO6: Apply concurrency control and solve deadlock problems.

CO7: Explain recovery methods and storage systems in databases.

Topics and Learning Points

Units	Title & Content	No. of Lectures
Unit 1	<p>Fundamentals of RDBMS (04 Lectures)</p> <ul style="list-style-type: none"> • Difference between DBMS & RDBMS • Features and Applications of RDBMS • Basic Terminologies: Relation, Attribute, Domain, Tuple, Entities, Degree • Codd's Rules for RDBMS (Overview) • Relational Model: Structure of Relational Database • Role & Responsibilities of Database Administrator (DBA) 	04
Unit 2	<p>PL/SQL Programming</p> <ul style="list-style-type: none"> • Block Structure of PL/SQL • Variables and Data Types (%TYPE, %ROWTYPE) • Operators & Functions (Numeric, Character, Date) • Control Statements (IF, LOOP, WHILE, FOR) • Exception Handling (Predefined & User-defined) • Views (Introduction, Examples) • Functions and Procedures (Definition, Examples) • Cursors: Implicit & Explicit, Parameterized, Attributes • Triggers (Introduction, Examples) • Packages (Overview) 	12
Unit 3	<p>Transaction Management</p> <ul style="list-style-type: none"> • Concept of Transaction • ACID Properties of Transactions • Transaction States • Concurrent Execution of Transactions • Serializability: Conflict & View Serializability 	08

	<ul style="list-style-type: none"> • Recoverability in Transactions: <ul style="list-style-type: none"> ○ Recoverable Schedule ○ Cascadeless Schedule 	
Unit 4	<p>Concurrency Control and Recovery</p> <ul style="list-style-type: none"> • Lock-based Protocols: Types of Locks, Granting of Locks • Two-Phase Locking Protocol (2PL) • Timestamp-based Protocols (Ordering, Thomas Write Rule) • Validation-based Protocol • Deadlock Prevention • Deadlock Detection & Recovery • Failure Classification: Transaction Failure, System Crash, Disk Failure • Recovery Techniques (Basics) • Storage Structures: Primary, Secondary & Tertiary Storage • Data Access Methods (Overview) 	06

Reference Books:

1. Database System Concepts By Henry korth and A. Silberschatz S. Sudarshan, Tata McGraw- Hill Education
2. Fundamentals of Database Systems, By: Elmasri and Navathe, 4th Edition Practical PostgreSQL O'REILLY
3. SQL/PLSQL the programming language of oracle Ivan Bayross BPB Publications New Delhi.
4. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw- Hill Science/Engineering/Math; 3 Edition
5. PostgreSQL Query Optimization: The Ultimate Guide to Building Efficient Queries 1st ed. Edition by Henrietta Dombrovskaya (Author), Boris Novikov (Contributor), Anna Bailliekova (Contributor)

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	3	1	1	1	1	1	1	2	2	1	1	1	1
CO2	3	2	2	2	2	2	2	2	2	1	2	2	2
CO3	2	3	3	3	3	2	2	3	3	2	2	3	2
CO4	2	3	3	3	3	3	3	3	3	2	2	3	2
CO5	3	2	2	2	2	2	2	2	2	1	2	2	1
CO6	2	3	3	3	3	3	3	3	3	2	2	3	2
CO7	3	2	2	2	2	2	3	2	3	1	3	2	2

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

Justification of Mapping of PO1 with All CO'S

CO1: PO1: provides foundational understanding of DBMS and RDBMS concepts essential for comprehensive knowledge.

CO2: PO1: enhances conceptual understanding of relational models and database management principles.

CO3: PO1: applies theoretical knowledge to practical PL/SQL programming tasks.

CO4: PO1: integrates knowledge of advanced PL/SQL components for deeper comprehension.

CO5: PO1: strengthens conceptual clarity on transaction processing and ACID properties.

CO6: PO1: applies theoretical concurrency control knowledge to real-world database issues.

CO7: PO1: deepens understanding of recovery and storage mechanisms within database systems.

Justification of Mapping of PO2 with All CO'S

CO1: PO2: introduces basic database terminology useful for understanding professional database applications.

CO2: PO2: connects relational concepts and DBA duties to real-world database management practices.

CO3: PO2: develops practical PL/SQL programming skills required in professional environments.

CO4: PO2: builds procedural and functional database expertise applicable to industry standards.

CO5: PO2: applies theoretical knowledge of transactions and ACID properties in practical scenarios.

CO6: PO2: trains students in handling concurrency and deadlock issues common in real-world systems.

CO7: PO2: enhances procedural knowledge of recovery and storage management used in professional database systems.

Justification of Mapping of PO3 with All CO'S

CO1: PO3: builds conceptual clarity that supports analytical reasoning in database problem-solving.

CO2: PO3: encourages logical understanding of relational structures and normalization for better design solutions.

CO3: PO3: involves writing and debugging PL/SQL programs requiring analytical and logical skills.

CO4: PO3: promotes problem-solving through use of advanced PL/SQL constructs like triggers and cursors.

CO5: PO3: develops critical thinking to verify ACID properties and analyze transaction schedules.

CO6: PO3: applies analytical reasoning to detect, prevent, and resolve concurrency and deadlock issues.

CO7: PO3: enhances problem-solving through understanding of recovery techniques and data storage optimization.

Justification of Mapping of PO4 with All CO'S

CO1: PO4: provides essential theoretical grounding that supports communication of technical concepts.

CO2: PO4: builds analytical and management understanding useful for professional competency as a DBA.

CO3: PO4: enhances technical proficiency and coding skills necessary for real-world database problem-solving.

CO4: PO4: develops specialized PL/SQL skills for advanced database operations and innovation in programming tasks.

CO5: PO4: strengthens analytical ability to assess and ensure transaction consistency and reliability.

CO6: PO4: cultivates problem-solving and decision-making skills in handling concurrency and deadlock situations.

CO7: PO4: builds competency in recovery and storage management, key specialized areas of database administration.

Justification of Mapping of PO5 with All CO'S

CO1: PO5: introduces fundamental database concepts that form the base for practical application and reasoning.

CO2: PO5: connects theoretical relational models to practical database design and analytical

tasks.

CO3: PO5: applies learned concepts through hands-on PL/SQL programming to solve practical database problems.

CO4: PO5: promotes analytical and creative problem-solving using advanced PL/SQL features in real scenarios.

CO5: PO5: involves analyzing transaction behavior to ensure adherence to ACID rules through logical reasoning.

CO6: PO5: demonstrates analytical and problem-solving skills by managing concurrency and resolving deadlocks.

CO7: PO5: applies reasoning to understand and implement effective recovery and storage mechanisms.

Justification of Mapping of PO6 with All CO'S

CO1: PO6: helps students articulate fundamental database concepts clearly in discussions or presentations.

CO2: PO6: encourages effective communication of relational models and DBA responsibilities within team settings.

CO3: PO6: involves explaining and documenting PL/SQL program logic during collaborative lab work.

CO4: PO6: promotes teamwork and communication while designing and debugging complex PL/SQL components.

CO5: PO6: requires clear explanation and group discussion of transaction management and ACID properties.

CO6: PO6: fosters collaborative problem-solving and effective communication in resolving concurrency and deadlock issues.

CO7: PO6: enhances ability to convey recovery and storage strategies through reports and group tasks.

Justification of Mapping of PO7 with All CO'S

CO1: PO7: provides basic theoretical knowledge that supports research in database systems.

CO2: PO7: helps in formulating research questions related to relational models and DBA practices.

CO3: PO7: involves designing and testing PL/SQL programs as part of experimental research methodology.

CO4: PO7: enables advanced database experimentation and analysis through use of exceptions, views, functions, cursors, and triggers.

CO5: PO7: develops analytical skills for evaluating transactions and ACID compliance in research contexts.

CO6: PO7: strengthens problem-solving and investigative skills for concurrency control and deadlock resolution studies.

CO7: PO7: facilitates research into recovery methods and storage architectures through analytical exploration and documentation.

Justification of Mapping of PO8 with All CO'S

- CO1: PO8:** builds a foundation for self-directed learning by understanding DBMS and RDBMS fundamentals.
- CO2: PO8:** encourages independent exploration of relational models, rules, and DBA duties.
- CO3: PO8:** develops self-learning skills through hands-on practice in PL/SQL programming.
- CO4: PO8:** fosters adaptability by exploring advanced PL/SQL features through self-guided learning.
- CO5: PO8:** promotes independent evaluation of transaction schedules and ACID compliance.
- CO6: PO8:** strengthens problem-solving through self-directed learning of concurrency control and deadlock resolution techniques.
- CO7: PO8:** encourages independent learning about recovery methods and storage systems to adapt to evolving database needs.
-

Justification of Mapping of PO9 with All CO'S

- CO1: PO9:** builds a conceptual base for using ICT tools in database study and analysis.
- CO2: PO9:** develops ability to use software tools for relational model design and DBA duties.
- CO3: PO9:** directly develops technical proficiency in PL/SQL programming using database software.
- CO4: PO9:** strengthens digital skills through advanced PL/SQL features and database tools.
- CO5: PO9:** applies ICT tools to analyze transaction schedules and verify ACID compliance.
- CO6: PO9:** enhances practical technological skills for implementing concurrency control and deadlock resolution.
- CO7: PO9:** develops expertise in database recovery tools and storage systems using modern ICT solutions.
-

Justification of Mapping of PO10 with All CO'S

- CO1: PO10:** develops basic awareness of diverse perspectives in database concepts.
- CO2: PO10:** introduces relational models and DBA duties in a context that may involve collaborative multicultural settings.
- CO3: PO10:** enhances collaboration skills through team-based PL/SQL programming tasks involving diverse perspectives.
- CO4: PO10:** fosters inclusive teamwork when developing advanced PL/SQL solutions in group projects.
- CO5: PO10:** involves limited direct application to multicultural competence, but may require

collaborative discussion of transaction issues.

CO6: PO10: encourages cooperative problem-solving in concurrency control and deadlock resolution with diverse teams.

CO7: PO10: provides limited direct relevance but can involve collaborative sharing of recovery and storage strategies.

Justification of Mapping of PO11 with All CO'S

CO1: PO11: builds ethical awareness by understanding responsible use of database technologies.

CO2: PO11: encourages ethical database design and management practices aligned with professional responsibilities.

CO3: PO11: fosters ethical coding practices in PL/SQL program development.

CO4: PO11: promotes responsible use of advanced PL/SQL features, considering best practices and ethical implications.

CO5: PO11: involves evaluating transactions in an ethical manner to ensure data integrity and trustworthiness.

CO6: PO11: reinforces responsible handling of concurrency control and deadlock problems.

CO7: PO11: emphasizes ethical responsibility in designing recovery methods and storage systems to ensure data preservation and sustainability.

Justification of Mapping of PO12 with All CO'S

CO1: PO12: builds independent understanding of DBMS and RDBMS concepts as a foundation for responsibility.

CO2: PO12: develops accountability in applying relational models and DBA duties.

CO3: PO12: enhances autonomy through independent development and testing of PL/SQL programs.

CO4: PO12: promotes responsible and independent handling of exceptions, views, functions, cursors, and triggers.

CO5: PO12: fosters accountability in ensuring transaction correctness and ACID compliance.

CO6: PO12: strengthens responsibility and autonomy in solving concurrency control and deadlock issues.

CO7: PO12: encourages independent design and accountability in recovery methods and storage system management.

Justification Mapping of PO13 with All CO'S

CO1: PO13: provides basic database knowledge that can support community-oriented projects involving data.

CO2: PO13: equips students with relational model knowledge useful for designing

community-based database systems.

CO3: PO13: develops practical programming skills that can be applied in community service projects.

CO4: PO13: enables development of functional database solutions useful for societal applications.

CO5: PO13: builds understanding of transactions that can indirectly support reliable community database applications.

CO6: PO13: fosters problem-solving skills useful in collaborative projects addressing societal needs.

CO7: PO13: supports responsible management of database systems used in community services.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Major Mandatory [Practical]
Course Code	: BCA-253-MRM
Course Title	: Lab Course based on BCA-251-MRM
No. of Credits	: 02
No. of Teaching Hours	: 60

Prerequisites:

1. Basic knowledge of algorithms and problem solving.
2. Know arrays, stacks, recursion, searching/sorting and Big-O analysis.

Course Objectives:

1. To understand concepts and operations of advanced data structures.
2. To study queues, trees, graphs, and hash tables in detail.
3. To analyze algorithms using time and space complexity.
4. To implement data structures using recursion and iteration.
5. To develop efficient searching, sorting, and optimization solutions.
6. To enhance logical thinking and problem-solving abilities.
7. To apply data structures in real-world domains like databases, AI, and networking.

Course Outcomes:

By the end of the course, students will be able to:

CO1: Demonstrate understanding of advanced data structures and their operations.

CO2: Implement queues, trees, graphs, and hash tables using programming.

CO3: Analyze algorithms for efficiency in terms of time and space complexity.

CO4: Apply recursion and iterative methods to solve data structure problems.

CO5: Design efficient solutions for searching, sorting, and optimization tasks.

CO6: Develop logical reasoning and problem-solving skills through applications.

CO7: Apply advanced data structures to real-world domains such as databases, compilers, AI, and networking.

Suggested Practical Assignments

Sr. No.	Assignment Name
Assignment 1	Implementation of Linear Queue using arrays. (Insert, Delete).
Assignment 2	Implementation of Linear Queue using Linked List. (Insert, Delete).
Assignment 3	Implementation of Circular Queue using arrays.
Assignment 4	Based on Queue Application
Assignment 5	Simple Tree Creation.
Assignment 6	Binary Tree Creation.
Assignment 7	Binary Tree Traversals – Inorder, Preorder, Postorder (recursive).
Assignment 8	Based on Tree Application
Assignment 9	Graph Representation – Adjacency Matrix & Adjacency List.
Assignment 10	Graph Traversals – BFS and DFS (recursive & non-recursive).
Assignment 11	Based on Graph Application
Assignment 12	Hash Table Implementation
Assignment 13	Hash Table Implementation
-	Mini Project

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	3	2	1	2	2	1	2	2	2	1	1	2	1
CO2	2	3	1	3	3	2	2	3	3	1	1	3	1
CO3	3	2	2	3	3	1	3	3	3	1	2	3	1
CO4	2	3	1	2	3	1	2	2	2	1	1	2	1
CO5	3	3	2	3	3	2	3	3	3	2	2	3	2
CO6	2	2	3	3	3	2	2	3	3	2	2	3	2
CO7	3	3	3	3	3	3	3	3	3	2	2	3	2

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

Justification of Mapping of PO1 with All CO'S

PO1:CO1: Understanding advanced data structures directly contributes to comprehensive knowledge of the field.

PO1:CO2: Implementation involves applying knowledge practically, showing moderate linkage to conceptual understanding.

PO1:CO3: Analyzing algorithm efficiency is a key theoretical aspect that enhances foundational understanding.

PO1:CO4: Application of recursion and iteration builds conceptual clarity but focuses more on practical implementation.

PO1:CO5: Designing efficient solutions requires a strong grasp of theoretical and conceptual knowledge.

PO1:CO6: Logical reasoning and problem-solving show understanding but emphasize skill development.

PO1:CO7: Applying advanced data structures in real-world domains require comprehensive multidisciplinary understanding.

Justification of Mapping of PO2 with All CO'S

PO2:CO1: Understanding operations supports professional application but focuses more on conceptual grasp.

PO2:CO2: involves hands-on programming and application of procedural knowledge.

PO2:CO3: Analytical skills support professional decision making but not direct implementation.

PO2:CO4: Practical skill directly applicable in programming and professional problem solving.

PO2:CO5: Aligns with professional ability to design efficient and optimized solutions.

PO2:CO6: Supports professional competence through skill building, though broader in nature.

PO2:CO7: Direct application of procedural knowledge in professional and real world contexts.

Justification of Mapping of PO3 with All CO'S

PO3:CO1: Foundational understanding supports analytical thinking useful for innovation, but not directly entrepreneurial.

PO3:CO2: Practical coding may assist in building prototypes or technical solutions, but link to entrepreneurship is indirect.

PO3:CO3: Efficiency analysis is vital in developing optimized products or start-ups involving tech solutions.

PO3:CO4: Enhances logical thinking but minimal direct link to entrepreneurship.

PO3:CO5: Solution design aligns with innovative and problem-solving mind-set essential for entrepreneurship.

PO3:CO6: Fosters innovation, creativity, and strategic problem-solving crucial for an entrepreneurial mind-set.

PO3:CO7: Encourages practical innovation and identification of opportunities using advanced technologies.

Justification of Mapping of PO4 with All CO'S

PO4:CO1: Builds analytical understanding and technical foundation for specialized skill development.

PO4:CO2: Enhances hands-on technical proficiency and programming competency.

PO4:CO3: Promotes analytical and problem-solving abilities essential for specialized technical roles.

PO4:CO4: Strengthens logical thinking and structured problem-solving approach.

PO4:CO5: Directly linked to innovation and technical excellence.

PO4:CO6: Core competency for analytical and adaptive professional growth.

PO4:CO7: Integrates domain-specific technical knowledge with real-world application and innovation.

Justification of Mapping of PO5 with All CO'S

PO5:CO1: Understanding structure operations supports analytical reasoning but less direct application.

PO5:CO2: Involves direct application of learned concepts to solve computational problems.

PO5:CO3: Requires analytical reasoning and problem-solving to evaluate performance.

PO5:CO4: Demonstrates practical problem-solving and creative application of logic.

PO5:CO5: Promotes analytical thinking and innovative problem-solving in real-world contexts.

PO5:CO6: Directly builds analytical and reasoning capacity.

PO5:CO7: Integrates applied knowledge with complex real-world problem-solving.

Justification of Mapping of PO6 with All CO'S

PO6:CO1: Understanding supports technical communication, but collaboration aspects are limited.

PO6:CO2: Coding tasks often require teamwork and peer collaboration during implementation.

PO6:CO3: May involve documentation and presentation of analytical results, but not core communication-focused.

PO6:CO4: Primarily technical, with minimal link to communication or teamwork.

PO6:CO5: Designing and presenting optimized solutions requires teamwork and clear explanation.

PO6:CO6: Collaboration and communication often enhance reasoning and group-based problem-solving.

PO6:CO7: Real-world applications typically require teamwork, interdisciplinary communication, and leadership.

Justification of Mapping of PO7 with All CO'S

PO7:CO1: Foundational understanding supports exploring new algorithms and research questions in computing.

PO7:CO2: Practical implementation aids in developing experimental setups for algorithmic research.

PO7:CO3: Directly contributes to research methodologies involving performance evaluation and comparative studies.

PO7:CO4: Useful for experimenting with problem-solving approaches and analyzing results.

PO7:CO5: Fosters innovation, exploration, and formulation of new algorithmic ideas for research.

PO7:CO6: Essential for formulating research hypotheses and drawing analytical conclusions.

PO7:CO7: Involves applying research and innovation to real-world computational domains.

Justification of Mapping of PO8 with All CO'S

PO8:CO1: Understanding complex data structures encourages independent study and conceptual clarity.

PO8:CO2: Involves hands-on, self-driven learning and adapting to coding challenges.

PO8:CO3: Requires independent analytical thinking and continuous improvement through learning.

PO8:CO4: Develops persistence and self-learning in mastering algorithmic techniques.

PO8:CO5: Promotes innovation, exploration, and adaptive learning for better solutions.

PO8:CO6: Strengthens the habit of continuous learning and self-improvement.

PO8:CO7: Involves lifelong learning and adapting to evolving technologies and domains.

Justification of Mapping of PO9 with All CO'S

PO9:CO1: Builds conceptual knowledge essential for understanding digital and computational technologies.

PO9:CO2: Directly involves hands-on programming and use of ICT tools for implementation

PO9:CO3: Applies analytical tools and computational thinking central to digital proficiency.

PO9:CO4: Reinforces computational logic and coding abilities in technological contexts.

PO9:CO5: Requires algorithmic thinking and software-based solution design.

PO9:CO6: Strengthens use of digital tools and computational reasoning for solving problems.

PO9:CO7: Directly applies ICT and technology-driven knowledge to real-world systems.

Justification of Mapping of PO10 with All CO'S

PO10:CO1: Conceptual understanding has minimal connection to teamwork or empathy aspects.

PO10:CO2: Involves collaboration and peer interaction in group programming tasks.

PO10:CO3: Limited but can encourage consideration of user or system diversity in solutions.

PO10:CO4: Technical in nature, minor relevance to multicultural or inclusive skills.

PO10:CO5: Problem-solving in diverse teams can foster inclusivity and respect for different approaches.

PO10:CO6: Collaborative problem-solving promotes empathy and inclusiveness in diverse environments.

PO10:CO7: Applying data structures in global and multicultural technology contexts supports diversity and empathy.

Justification of Mapping of PO11 with All CO'S

PO11:CO1: Basic conceptual knowledge offers limited connection to ethics or environmental awareness.

PO11:CO2: Technical practice can encourage responsible coding and ethical data handling.

PO11:CO3: Efficient algorithms promote sustainable computing through optimized resource use.

PO11:CO4: Technical skill development, with minor indirect contribution to ethical awareness.

PO11:CO5: Designing efficient systems contributes to environmental sustainability through reduced computational waste.

PO11:CO6: Fosters responsible decision-making and ethical problem-solving.

PO11:CO7: Promotes ethical and sustainable application of technology in real-world contexts.

Justification of Mapping of PO12 with All CO'S

PO12:CO1: Conceptual mastery supports independent learning and responsible application.

PO12:CO2: Requires self-directed work, accuracy, and accountability in code development.

PO12:CO3: Fosters independent analysis and responsibility for delivering optimized solutions.

PO12:CO4: Enhances self-reliance in problem-solving and method selection.

PO12:CO5: Demands autonomy in designing and evaluating solutions responsibly.

PO12:CO6: Promotes independent critical thinking and accountable decision-making.

PO12:CO7: Demonstrates independent application of knowledge in complex, real-world contexts.

Justification of Mapping of PO13 with All CO'S

PO13:CO1: Foundational knowledge may indirectly support community-focused technical initiatives.

PO13:CO2: Programming skills could assist in community or social-impact software solutions.

PO13:CO3: Analytical efficiency can benefit projects aimed at social good (e.g., data processing for NGOs).

PO13:CO4: Technical problem solving supports contribution to community-based systems.

PO13:CO5: Optimized solutions can be applied in civic or social applications (e.g., resource allocation systems).

PO13:CO6: Critical thinking fosters innovative approaches to community challenges.

PO13:CO7: Real-world application of DS concepts can extend to social, environmental, or civic data systems.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Vocational Skill Course (VSC) [Theory]
Course Code	: BCA-254-VSC
Course Title	: Object Oriented Programming using Java.
No. of Credits	: 02
No. of Teaching Hours	: 30

Prerequisites:

1. Basic Programming Concepts – Variables, data types, operators, control structures (if, switch, loops).
2. Problem-Solving Skills – Flowcharts, algorithms, and pseudo-code.
3. Procedural Programming Concepts – Functions, arrays, strings, structures.

Course Objectives:

1. To understand the basics of Java and its features.
2. To learn how to write simple Java programs.
3. To study classes, objects, constructors, and packages.
4. To apply concepts of inheritance, overriding, and interfaces.
5. To understand and use exception handling in Java.
6. To work with strings and their built-in methods.
7. To perform basic file handling and I/O operations in Java.

Course Outcomes:

By the end of the course, students will be able to:

CO1: Explain Java features and write basic Java programs.

CO2: Use data types, variables, arrays, and input methods.

CO3: Create classes, objects, constructors, and packages.

CO4: Apply inheritance, polymorphism, and interfaces in programs.

CO5: Handle errors using exceptions in Java.

CO6: Work with strings and string buffer methods.

CO7: Read, write, and manage files using Java I/O streams.

Topics and Learning Points

Units	Title & Content	No. of Lectures
Unit 1	<p>Introduction to Java & Basic Programming</p> <ol style="list-style-type: none"> 1. Introduction to Java <ul style="list-style-type: none"> ○ Features (Buzzwords of Java) ○ Java Environment: JDK, JRE, JVM ○ Compilation & Execution (javac, java) 2. Java Basics <ul style="list-style-type: none"> ○ Structure of a Java Program ○ main() method ○ Using IDEs: Eclipse/NetBeans (Demonstration only) 3. Language Fundamentals <ul style="list-style-type: none"> ○ Types of Comments ○ Data Types (Primitive and Non-Primitive) ○ Variables and Constants (final variables) 4. Arrays <ul style="list-style-type: none"> ○ 1D Array ○ 2D Array ○ Basic operations on arrays 5. Input Methods <ul style="list-style-type: none"> ○ Command line arguments ○ BufferedReader class ○ Scanner class 	08
Unit 2	<p>Classes, Objects & Packages</p> <ol style="list-style-type: none"> 1. Defining and Creating Classes & Objects <ul style="list-style-type: none"> ○ Class definition and object creation ○ Instance variables and methods 2. Access Specifiers <ul style="list-style-type: none"> ○ public, private, protected, default ○ Scope and accessibility 3. Array of Objects <ul style="list-style-type: none"> ○ Creating and accessing objects in an array 4. Constructors <ul style="list-style-type: none"> ○ Default Constructor ○ Parameterized Constructor ○ Constructor Overloading ○ Use of this keyword 5. Static Members <ul style="list-style-type: none"> ○ Static variables ○ Static methods ○ Static block 	08

	6. Packages <ul style="list-style-type: none"> ○ Creating user-defined packages ○ Importing packages ○ Built-in packages (java.util, java.lang) 	
Unit 3	Inheritance & Interfaces <ol style="list-style-type: none"> 1. Inheritance Basics <ul style="list-style-type: none"> ○ extends keyword ○ Types of inheritance: Single, Multilevel, Hierarchical 2. Superclass & Subclass <ul style="list-style-type: none"> ○ Accessing superclass members ○ Use of super keyword 3. Method Overriding <ul style="list-style-type: none"> ○ Overriding methods ○ Runtime polymorphism 4. Use of final keyword <ul style="list-style-type: none"> ○ final variable, final method, final class 5. Abstract Classes <ul style="list-style-type: none"> ○ Abstract class and abstract methods ○ Implementation examples 6. Interfaces <ul style="list-style-type: none"> ○ Defining and implementing interfaces ○ Multiple inheritance using interfaces ○ Runtime polymorphism using interfaces 	07
Unit 4	Exception Handling, Strings & File I/O <ol style="list-style-type: none"> 1. Exception Handling Basics <ul style="list-style-type: none"> ○ Errors and exceptions ○ Exception hierarchy ○ Checked vs Unchecked exceptions 2. Exception Handling Mechanisms <ul style="list-style-type: none"> ○ try, catch, throw, throws, finally ○ Creating user-defined exceptions 3. Strings in Java <ul style="list-style-type: none"> ○ String class and its methods ○ StringBuffer class ○ String formatting (format() method) 4. File Handling Basics <ul style="list-style-type: none"> ○ File class ○ Creating files and directories 	07

Reference /Text Books:

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

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

Justification of Mapping of PO1 with All CO'S

CO1: PO1: Understanding Java features and writing basic programs reflects strong foundational and theoretical knowledge of programming principles.

CO2: PO1: Using data types, variables, and arrays demonstrates comprehensive understanding of core programming concepts.

CO3: PO1: Creating classes, objects, and packages shows strong grasp of object-oriented principles and methodologies.

CO4: PO1: Applying inheritance, polymorphism, and interfaces requires deep conceptual understanding of advanced OOP theories.

CO5: PO1: Handling exceptions shows moderate understanding of Java's error management principles and their practical use.

CO6: PO1: Working with strings and string buffers indicates moderate understanding of data manipulation and memory concepts.

CO7: PO1: Managing files using I/O streams reflects moderate theoretical and practical understanding of Java's file-handling mechanisms.

Justification of Mapping of PO2 with All CO'S

CO1: PO2: Writing basic Java programs provides moderate practical exposure to coding and procedural implementation.

CO2: PO2: Using data types, variables, and arrays develops strong procedural and professional coding skills applicable in real-world programming.

CO3: PO2: Creating classes, objects, and packages builds strong practical and structural programming expertise aligned with industry standards.

CO4: PO2: Applying inheritance, polymorphism, and interfaces demonstrates strong professional competence in object-oriented programming practices.

CO5: PO2: Handling exceptions effectively enhances professional coding reliability and procedural error management skills.

CO6: PO2: Working with strings and buffers offers moderate procedural understanding for handling text and optimizing performance in applications.

CO7: PO2: Managing files through Java I/O streams strongly relates to professional, real-world programming tasks and procedural operations.

Justification of Mapping of PO3 with All CO'S

CO1: PO3: Learning Java basics partially contributes to developing problem-solving skills useful for innovative thinking.

CO2: PO3: Using data types and arrays offers limited but foundational logical skills applicable to entrepreneurial software solutions.

CO3: PO3: Creating classes and packages moderately fosters structured thinking essential for designing innovative and scalable applications.

CO4: PO3: Applying OOP concepts like inheritance and polymorphism encourages modular and reusable design thinking useful in product development.

CO5: PO3: Handling exceptions promotes risk assessment and management skills relevant to reliable software solutions.

CO6: PO3: Working with strings provides minimal connection to innovation but supports data processing in business-oriented applications.

CO7: PO3: Managing files with I/O streams moderately relates to developing real-world applications that can serve entrepreneurial or business needs.

Justification of Mapping of PO4 with All CO'S

CO1: PO4: Explaining Java features and writing programs moderately enhances analytical thinking and communication of technical concepts.

CO2: PO4: Using data types, variables, and arrays develops strong analytical and problem-solving abilities in coding tasks.

CO3: PO4: Creating classes and packages demonstrates strong technical proficiency and structured problem-solving skills.

CO4: PO4: Applying inheritance and polymorphism reflects advanced analytical and adaptive programming competence.

CO5: PO4: Handling exceptions strengthens problem-solving and debugging skills essential for specialized technical expertise.

CO6: PO4: Working with strings and buffers moderately enhances data handling efficiency and adaptability in different scenarios.

CO7: PO4: Managing files using Java I/O streams shows strong technical competency and adaptability in real-world programming challenges.

Justification of Mapping of PO5 with All CO'S

CO1: PO5: Explaining Java features and writing programs moderately develops analytical reasoning and logical application skills.

CO2: PO5: Using data types, variables, and arrays strongly enhances practical application and structured problem-solving abilities.

CO3: PO5: Creating classes and objects fosters strong analytical reasoning and real-world problem-solving through modular design.

CO4: PO5: Applying inheritance and polymorphism demonstrates strong ability to analyze and solve complex programming problems creatively.

CO5: PO5: Handling exceptions builds strong problem-solving capacity by managing and rectifying runtime errors effectively.

CO6: PO5: Working with strings and buffers moderately contributes to analytical thinking in processing and manipulating data.

CO7: PO5: Managing files with Java I/O streams strongly relates to practical application and analytical reasoning in real-world data handling.

Justification of Mapping of PO6 with All CO'S

CO1: PO6: Explaining Java features and writing programs moderately improves technical communication and presentation of programming logic.

CO2: PO6: Using data types and arrays partially contributes to collaborative coding discussions and documentation.

CO3: PO6: Creating classes and packages moderately enhances teamwork in modular program development and integration.

CO4: PO6: Applying inheritance and interfaces encourages collaboration through clear code design and shared understanding among team members.

CO5: PO6: Handling exceptions partially relates to communicating and resolving technical issues within a development team.

CO6: PO6: Working with strings provides limited contribution to collaboration, mainly through data formatting and code clarity.

CO7: PO6: Managing files with I/O streams moderately supports effective communication of data management processes within team-based projects.

Justification of Mapping of PO7 with All CO'S

CO1: PO7: Explaining Java features and writing basic programs partially supports analytical observation and logical reasoning for research tasks.

CO2: PO7: Using data types and arrays moderately develops data organization and analytical skills useful in research computations.

CO3: PO7: Creating classes and packages moderately fosters structured thinking and methodological design applicable in research projects.

CO4: PO7: Applying inheritance and polymorphism encourages systematic problem formulation and model-based research thinking.

CO5: PO7: Handling exceptions supports analytical observation and the evaluation of alternative solutions during experimentation.

CO6: PO7: Working with strings offers limited contribution but helps in processing textual or experimental data for analysis.

CO7: PO7: Managing files using Java I/O streams strongly relates to research data collection, storage, and analysis methodologies.

Justification of Mapping of PO8 with All CO'S

CO1: PO8: Learning Java features and writing programs strongly promotes self-directed learning and adaptability to new programming environments.

CO2: PO8: Using data types and arrays moderately encourages independent exploration of coding logic and problem-solving approaches.

CO3: PO8: Creating classes and packages strongly builds self-learning ability through understanding modular design and program structure.

CO4: PO8: Applying inheritance and polymorphism fosters continuous learning and adaptation to advanced programming concepts.

CO5: PO8: Handling exceptions moderately develops independent debugging and analytical learning strategies.

CO6: PO8: Working with strings and buffers encourages moderate self-learning to manage data efficiently in diverse coding scenarios.

CO7: PO8: Managing files using Java I/O streams strongly supports independent learning of real-world data handling and system interaction.

Justification of Mapping of PO9 with All CO'S

CO1: PO9: Learning Java features and writing programs strongly enhances digital literacy and proficiency in modern programming environments.

CO2: PO9: Using data types, variables, and arrays strongly develops computational and technological problem-solving abilities.

CO3: PO9: Creating classes, objects, and packages demonstrates strong use of ICT tools and modern programming technologies.

CO4: PO9: Applying inheritance, polymorphism, and interfaces strongly builds technological competence in object-oriented software development.

CO5: PO9: Handling exceptions moderately contributes to the use of advanced programming tools for reliable software systems.

CO6: PO9: Working with strings and buffers moderately improves efficiency in handling digital data within software applications.

CO7: PO9: Managing files using Java I/O streams strongly relates to practical technological skills in data access, storage, and analysis.

Justification of Mapping of PO10 with All CO'S

CO1: PO10: Explaining Java features and writing programs partially supports teamwork and respect for diverse learning approaches.

CO2: PO10: Using data types and arrays offers limited relation but encourages patience and understanding while collaborating with peers.

CO3: PO10: Creating classes and packages moderately promotes collaborative coding and appreciation of diverse design ideas.

CO4: PO10: Applying inheritance and interfaces moderately fosters teamwork by integrating diverse coding modules into a unified system.

CO5: PO10: Handling exceptions partially relates to understanding and managing diverse problem-solving perspectives empathetically.

CO6: PO10: Working with strings has minimal connection but supports clear communication through structured data handling.

CO7: PO10: Managing files with I/O streams moderately encourages shared understanding and cooperation in handling collaborative digital projects.

Justification of Mapping of PO11 with All CO'S

CO1: PO11: Explaining Java features and writing programs partially supports ethical coding practices and responsible software development.

CO2: PO11: Using data types and arrays has limited relation but encourages careful and responsible handling of data.

CO3: PO11: Creating classes and packages moderately promotes ethical design and sustainable software architecture.

CO4: PO11: Applying inheritance and polymorphism moderately fosters efficient and responsible reuse of code, supporting sustainability.

CO5: PO11: Handling exceptions encourages ethical responsibility in ensuring software reliability and minimizing harm.

CO6: PO11: Working with strings minimally supports value inculcation, mainly in structured and clear communication.

CO7: PO11: Managing files using I/O streams moderately relates to responsible data handling and ethical use of digital resources.

Justification of Mapping of PO12 with All CO'S

CO1: PO12: Explaining Java features and writing basic programs moderately develops independence and accountability in learning programming.

CO2: PO12: Using data types, variables, and arrays strongly builds practical independence and responsibility in program development.

CO3: PO12: Creating classes, objects, and packages strongly promotes autonomy and accountability in structuring and managing projects.

CO4: PO12: Applying inheritance and polymorphism strongly enhances independent design and responsibility for scalable software solutions.

CO5: PO12: Handling exceptions strongly reflects accountability in ensuring robust and reliable program execution.

CO6: PO12: Working with strings and buffers moderately supports independent coding practices and data management responsibility.

CO7: PO12: Managing files using Java I/O streams strongly relates to autonomy and responsibility in data handling and project execution.

Justification Mapping of PO13 with All CO'S

CO1: PO13: Explaining Java features and writing basic programs partially contributes to community engagement by enabling knowledge sharing.

CO2: PO13: Using data types and arrays has minimal relation but can support collaborative projects with community impact.

CO3: PO13: Creating classes and packages moderately encourages developing software solutions that could serve community needs.

CO4: PO13: Applying inheritance and polymorphism moderately supports building scalable applications for community use.

CO5: PO13: Handling exceptions has limited relation but ensures reliability in software that could benefit the community.

CO6: PO13: Working with strings provides minimal contribution, mainly in data processing for shared applications.

CO7: PO13: Managing files using Java I/O streams moderately supports data handling for community-focused projects and services.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Community Engagement Project (CEP) [Practical]
Course Code	: BCA-255-CEP
Course Title	: Community Engagement Project
No. of Credits	: 02
No. of Teaching Hours	: 60

Course Objectives:

1. To develop students ability to design and implement effective research questionnaires for Community-based studies.
2. To enhance students skills in collecting and analyzing socio-economic and environmental data.
3. To foster critical thinking and problem-solving through real-world research.
4. To deepen understanding of the relationship between human activities.
5. To promote active engagement with local communities to address research issues.
6. To build students competence in synthesizing and presenting research findings.
7. To prepare students for advanced academic research or professional roles in related fields

Course Outcomes:

By the end of the course, students will be able to:

- CO1:** Demonstrate the ability to design and implement effective research questionnaires for community-based studies.
- CO2:** Exhibit enhanced skills in collecting and analyzing research data.
- CO3:** Apply critical thinking and problem-solving skills in conducting real-world research.
- CO4:** Display a deeper understanding of the relationship between human activities.
- CO5:** Actively engage with local communities to address and resolve issues.
- CO6:** Demonstrate competence in synthesizing and presenting research findings clearly and effectively.

CO7: Prepare for advanced academic research or professional roles in related fields.

SOP for the Field/Community Engagement Project:

As per the NEP-2020 credit and course structure, students in UG programs are required to complete a two-credit Community Engagement Project (CEP) in SYBCA Semester IV to be eligible for the award of a B.C.A. degree. To meet this requirement, our Board of Studies has prepared a Standard Operating Procedure (SOP) and format for conducting the Project. The detailed SOPs are provided below.

1. Preparation of SOP and Course Material:

The Board of Studies (BOS) will prepare the SOP, project format, and curriculum for the Project coursework.

2. Notification to Students:

The department will issue a notice instructing students to attend the coursework for the Project.

3. Conducting Coursework:

The department will conduct the necessary coursework to prepare students for undertaking the Project.

4. Application for Guide Allocation:

Groups of three students will submit an application in the prescribed format to the HOD for the allocation of a Project guide.

5. Guide Allocation:

A departmental committee will allocate guides to students in accordance with the department's rules and policies.

6. Publication of list of students and guide:

The list of student groups and their allotted guides will be published.

7. Topic Finalization:

Students will meet with their assigned guide to finalize the topic of their Project.

8. Questionnaire Development:

Students will prepare a questionnaire under the guidance of their guide.

9. Fieldwork and Data Collection:

Students will conduct fieldwork/field surveys to collect relevant data and information.

10. Data Analysis and Presentation:

Students will analyze and present the collected data.

11. Project Preparation:

Students will prepare the Project report in the prescribed format provided by the department, under the guidance of their assigned guide.

12. Assessment and Evaluation:

The Project will be assessed and evaluated according to the guidelines provided by the exam department.

13. Inclusion of Geo-tagged Photographs:

The Project must include geo-tagged photographs of the fieldwork/survey.

14. Inclusion of Study Area Map:

The Project should contain a map of the study area.

15. Project Length:

The Project report should be between 30 to 35 pages

Expected Hours for Project Work:

Sr. No.	Activity	No of Hours
1	Planning and Preparation for Work	10
2	Fieldwork Data Collection	20
3.	Data Processing and Results	15
4.	Fieldwork Report Preparation and Presentation	15

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Minor [Theory]
Course Code	: BCA-256-MN
Course Title	: Digital Marketing
No. of Credits	: 02
No. of Teaching Hours	: 30

Prerequisites:

1. Basic knowledge of Computer skill and its concepts.
2. Fundamentals of ICT / Internet Concepts.
3. Knowledge of Social Media Platform.

Course Objectives:

1. To provide foundational knowledge of digital marketing concepts and their significance in the modern business landscape.
2. To differentiate between traditional and digital marketing approaches and understand various digital marketing channels.
3. To develop skills in website planning, social media strategies, and mobile marketing for brand promotion.
4. To develop an understanding of various digital marketing channels such as SEO, SEM, social media, content, and email marketing.
5. To enable students to design, implement, and evaluate simple digital marketing campaigns.
6. To encourage entrepreneurial and innovative thinking by applying digital marketing techniques for personal branding or startups.
7. To prepare students for professional opportunities and certifications in the field of digital marketing.

Course Outcomes:

By the end of the course, students will be able to:

- CO1:** Understand the fundamental concepts, principles, and components of digital marketing, including its importance in the modern business environment.
- CO2:** Analyze different digital marketing channels such as Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social Media Marketing (SMM), Content Marketing, Email Marketing, and Affiliate Marketing.
- CO3:** Develop skills to create, plan, and implement digital marketing strategies that enhance online presence and engagement.
- CO4:** Apply knowledge of web analytics and tools like Google Analytics to measure, interpret, and optimize digital marketing campaigns.
- CO5:** Evaluate ethical, legal, and privacy considerations in digital marketing practices and ensure compliance with regulations.
- CO6:** Integrate theoretical knowledge with practical insights to design effective digital marketing campaigns and assess their performance using Key Performance Indicators (KPIs).
- CO7:** Enhance critical thinking to adapt digital marketing strategies according to changing trends, technologies, and consumer behaviour.

Topics and Learning Points

Unit	Title and Contents	No. of Lectur
1	<p style="text-align: center;">Fundamentals of Digital Marketing</p> <p>1.1 Introduction to Digital Marketing</p> <p>1.2 Traditional vs Digital Marketing</p> <p>1.3 Digital Marketing Channels (SEO, SEM, SMM, Content, Email, Mobile)</p> <p>1.4 Customer Journey in Digital Marketing</p> <p>1.5 Latest Trends & Career Scope.</p>	06

2	<p style="text-align: center;">Website & Social Media Marketing</p> <p>2.1 Website planning for marketing (Domain, Hosting, CMS basics - Word Press)</p> <p>2.2 Importance of Landing Pages & Call-to-Action (CTA)</p> <p>2.3 Mobile Marketing & App Store Optimization (ASO)</p> <p>2.4 Affiliate Marketing & Influencer Marketing.</p> <p>2.5 Marketing Automation & AI in Digital Marketing</p> <p>2.6 Career Opportunities & Certifications (Google, HubSpot, Meta Ads overview)</p>	08
3	<p style="text-align: center;">Search Engine Optimization (SEO)</p> <p>3.1 Introduction to SEO and its importance</p> <p style="padding-left: 20px;">3.1.1 Search Engine Optimization (SEO) – Basics</p> <p>3.2 On-Page SEO (keywords, meta tags, content optimization, headings, images)</p> <p>3.3 Off-Page SEO (link building, bookmarking, guest posting)</p> <p>3.4 Technical SEO (site speed, mobile optimization, sitemap, robots.txt)</p> <p>3.5 SEO Tools (Google Search Console, Ubersuggest, SEMrush overview, Ahrefs)</p> <p>3.6 SEO Trends (Voice Search, Local SEO, AI & SEO)</p>	08
4	<p style="text-align: center;">Content Marketing, Email & Web Analytics</p> <p>4.1 Content Marketing: Blogs, Videos, Info graphics, Reels</p> <p>4.2 Content Strategy & Distribution</p> <p>4.3 Email Marketing Basics: Mail chimp, Newsletters, Drip campaigns</p> <p>4.4 Web Analytics</p> <p style="padding-left: 20px;">4.4.1 Introduction to Google Analytics</p> <p style="padding-left: 20px;">4.4.2 Key Metrics: traffic, bounce rate, CTR, conversions</p> <p style="padding-left: 20px;">4.4.3 Campaign Effectiveness</p>	08

References:

1. Digital Marketing: Strategy, Implementation and Practice – Dave Chaffey, Fiona Ellis-Chadwick, 8th Edition, Pearson, 2022.
2. Fundamentals of Digital Marketing – Alan Charlesworth, McGraw-Hill Education, 2020.

3. Digital Marketing for Dummies – Ryan Deiss & Russ Henneberry, Wiley, 2021.
4. Social Media Marketing: A Strategic Approach – Melissa Barker, Donald Barker, Nicholas Bormann, Debra Neher, Cengage, 2020.
5. Search Engine Optimization All-in-One for Dummies – Bruce Clay, Wiley, 2020.
6. Google Digital Garage – Fundamentals of Digital Marketing
URL: <https://learndigital.withgoogle.com/digitalgarage/course/digital-marketing>
7. HubSpot Academy – Digital Marketing Courses
URL: <https://academy.hubspot.com/courses/digital-marketing>

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	3	2	2	2	2	1	1	2	2	1	2	2	1
CO2	3	3	2	3	3	2	2	2	3	1	2	2	1
CO3	3	3	3	3	3	2	2	2	3	1	2	3	2
CO4	3	3	2	3	3	2	2	3	3	1	2	2	1
CO5	3	3	2	2	2	2	2	2	2	2	3	3	1
CO6	3	3	3	3	3	2	2	2	3	1	2	3	2
CO7	3	3	3	3	3	2	2	3	3	2	2	3	2

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

PO–CO Mapping Justification (Digital Marketing)

Justification of Mapping of PO1 with All CO'S

- PO1:CO1:** Establishes conceptual understanding of digital marketing fundamentals.
- PO1:CO2:** Builds detailed knowledge of diverse marketing channels.
- PO1:CO3:** Applies conceptual knowledge to strategic planning.
- PO1:CO4:** Strengthens understanding of analytical and performance tools.
- PO1:CO5:** Enhances awareness of theoretical and ethical frameworks.
- PO1:CO6:** Integrates theory with applied practices.
- PO1:CO7:** Develops conceptual flexibility to adapt to trends.

Justification of Mapping of PO2 with All CO'S

- PO2:CO1:** Connects theoretical learning to digital marketing practices.
- PO2:CO2:** Promotes practical knowledge of digital channels.
- PO2:CO3:** Develops ability to plan and execute marketing campaigns.
- PO2:CO4:** Demonstrates procedural understanding of analytics tools.
- PO2:CO5:** Applies ethical and legal principles in practice.
- PO2:CO6:** Implements learned techniques in real-world scenarios.
- PO2:CO7:** Adapts professional knowledge to emerging trends.

Justification of Mapping of PO3 with All CO'S

- PO3:CO1:** Encourages entrepreneurial awareness through marketing basics.
- PO3:CO2:** Applies marketing channels to business growth.
- PO3:CO3:** Develops strategic thinking for entrepreneurship.
- PO3:CO4:** Analyses data for entrepreneurial decision-making.
- PO3:CO5:** Promotes responsible business ethics.
- PO3:CO6:** Integrates creativity with market-focused strategy.
- PO3:CO7:** Adapts entrepreneurial ideas to technological shifts.

Justification of Mapping of PO4 with All CO'S

- PO4:CO1:** Enhances analytical understanding of marketing frameworks.
- PO4:CO2:** Applies analytical skills to manage diverse digital platforms.
- PO4:CO3:** Strengthens campaign planning and management.
- PO4:CO4:** Builds expertise in interpreting analytics data.
- PO4:CO5:** Demonstrates professionalism and ethical judgment.
- PO4:CO6:** Applies technical and leadership skills in campaign creation.
- PO4:CO7:** Demonstrates adaptability and leadership in evolving contexts.

Justification of Mapping of PO5 with All CO'S

- PO5:CO1:** Applies theoretical principles to practical marketing problems.
- PO5:CO2:** Analyzes and optimizes marketing strategies.
- PO5:CO3:** Demonstrates creativity and reasoning in decision-making.
- PO5:CO4:** Uses analytics for problem-solving in campaigns.
- PO5:CO5:** Evaluates legal and ethical problems effectively.
- PO5:CO6:** Measures campaign performance through data-driven reasoning.
- PO5:CO7:** Enhances critical thinking and adaptability.

Justification of Mapping of PO6 with All CO'S

- PO6:CO1:** Involves basic communication of marketing concepts.
- PO6:CO2:** Encourages effective presentation of strategies.
- PO6:CO3:** Promotes teamwork in campaign execution.
- PO6:CO4:** Communicates analytical findings effectively.
- PO6:CO5:** Promotes ethical and transparent communication.
- PO6:CO6:** Involves client and team collaboration.
- PO6:CO7:** Encourages adaptability in communication for new trends.

Justification of Mapping of PO7 with All CO'S

- PO7:CO1:** Introduces basic understanding of marketing analysis.
- PO7:CO2:** Promotes basic research of digital channels.
- PO7:CO3:** Encourages evidence-based marketing planning.
- PO7:CO4:** Applies research tools like Google Analytics.
- PO7:CO5:** Promotes inquiry into ethical and legal frameworks.
- PO7:CO6:** Encourages use of data to assess campaign outcomes.
- PO7:CO7:** Uses research to adapt to market changes.

Justification of Mapping of PO8 with All CO'S

- PO8:CO1:** Encourages ongoing learning of marketing concepts.
- PO8:CO2:** Promotes self-learning of marketing platforms.
- PO8:CO3:** Encourages continuous improvement in digital strategy.

- PO8:CO4:** Involves learning advanced analytical tools.
- PO8:CO5:** Promotes ethical learning and reflection.
- PO8:CO6:** Reinforces adaptability and self-assessment.
- PO8:CO7:** Strengthens lifelong learning and adaptability.

Justification of Mapping of PO9 with All CO'S

- PO9:CO1:** Introduces basic digital marketing tools.
- PO9:CO2:** Applies digital technology across platforms.
- PO9:CO3:** Designs technology-driven campaigns.
- PO9:CO4:** Utilizes web analytics and measurement tools.
- PO9:CO5:** Uses digital media responsibly.
- PO9:CO6:** Employs digital tools for campaign analysis.
- PO9:CO7:** Adapts to evolving digital technologies.

Justification of Mapping of PO10 with All CO'S

- PO10:CO1:** Shows minimal multicultural relevance.
- PO10:CO2:** Partially engages global digital audiences.
- PO10:CO3:** Promotes awareness of diverse markets.
- PO10:CO4:** Limited link to multicultural elements.
- PO10:CO5:** Encourages inclusive and ethical marketing.
- PO10:CO6:** Minimal direct cultural impact.
- PO10:CO7:** Promotes empathy for consumer behavior.

Justification of Mapping of PO11 with All CO'S

- PO11:CO1:** Encourages awareness of ethical marketing.
- PO11:CO2:** Promotes responsible online conduct.
- PO11:CO3:** Integrates ethical reasoning in strategy.
- PO11:CO4:** Promotes transparency in analytics.
- PO11:CO5:** Strongly upholds ethical and legal standards.
- PO11:CO6:** Promotes integrity in marketing execution.
- PO11:CO7:** Encourages ethical adaptation to trends.

Justification of Mapping of PO12 with All CO'S

- PO12:CO1:** Encourages independent learning.
- PO12:CO2:** Promotes responsibility in managing platforms.
- PO12:CO3:** Strengthens independent campaign planning.
- PO12:CO4:** Promotes responsible data handling.
- PO12:CO5:** Reinforces accountability in ethical compliance.
- PO12:CO6:** Demonstrates self-reliance in project outcomes.
- PO12:CO7:** Reflects accountability in adaptive strategies.

Justification of Mapping of PO13 with All CO'S

- PO13:CO1:** Minor relevance to social impact.
- PO13:CO2:** Limited connection to community awareness.
- PO13:CO3:** Can promote digital literacy and outreach.
- PO13:CO4:** Minimal direct relation.
- PO13:CO5:** Encourages social responsibility in ethics.
- PO13:CO6:** Supports community-based campaigns.
- PO13:CO7:** Applies marketing for societal benefit.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Minor [Practical]
Course Code	: BCA-257-MN
Course Title	: Lab Course Based on BCA-256-MN
No. of Credits	: 02
No. of Teaching Hours	: 60

Prerequisites:

1. Basic Computer Skills
2. Internet & Email Usage & Social Media Familiarity

Course Objectives:

1. Understand the core concepts, tools, and techniques used in digital marketing.
2. Differentiate between traditional and digital marketing methods through real-world case studies.
3. Explore various digital marketing channels such as SEO, SEM, SMM, Email, and Mobile marketing.
4. Develop skills to design, create, and manage websites and landing pages for marketing purposes.
5. Apply techniques for Search Engine Optimization (SEO), including on-page, off-page, and technical SEO.
6. Use digital analytics tools like Google Analytics to measure and enhance marketing performance.
7. Investigate emerging trends in AI, automation, influencer, and affiliate marketing for strategic advantage.

Course Outcomes:

By the end of the course, students will be able to:

CO1: Identify and evaluate different digital marketing channels and their roles in brand promotion.

- CO2:** Compare traditional and digital marketing approaches using analytical and creative perspectives.
- CO3:** Map customer journeys and create engaging marketing experiences through websites and landing pages.
- CO4:** Implement SEO strategies — including keyword research, on-page, off-page, and technical optimization.
- CO5:** Apply digital tools and techniques for mobile marketing, app store optimization, and campaign management.
- CO6:** Analyze website and campaign performance using Google Analytics and generate actionable insights.
- CO7:** Demonstrate practical knowledge of modern marketing technologies such as AI tools, automation, and influencer marketing platforms.

Suggested Practical Assignments:

Assignment No.	Assignment Name
1	Exploring Digital Marketing Channels
2	Traditional vs Digital Marketing Case Study
3	Mapping a Customer Journey
4	Creating a Basic Website using WordPress
5	Designing a Landing Page with CTA
6	Mobile Marketing & App Store Optimization (ASO)
7	Affiliate Marketing Research
8	Influencer Marketing Analysis
9	Exploring AI & Marketing Automation Tools
10	SEO Audit of a Website
11	Keyword Research using SEO Tools
12	On-Page SEO Optimization
13	Off-Page SEO Activity
14	Technical SEO Check
15	Google Analytics Dashboard Study or Mini Project

References:

1. Digital Marketing: Strategy, Implementation and Practice – Dave Chaffey, Fiona Ellis-Chadwick, 8th Edition, Pearson, 2022.

2. Fundamentals of Digital Marketing – Alan Charlesworth, McGraw-Hill Education, 2020.
3. Digital Marketing for Dummies – Ryan Deiss & Russ Henneberry, Wiley, 2021.
4. Social Media Marketing: A Strategic Approach – Melissa Barker, Donald Barker, Nicholas Bormann, Debra Neher, Cengage, 2020.
5. Search Engine Optimization All-in-One For Dummies – Bruce Clay, Wiley, 2020.
6. Google Digital Garage – Fundamentals of Digital Marketing
URL: <https://learndigital.withgoogle.com/digitalgarage/course/digital-marketing>
7. HubSpot Academy – Digital Marketing Courses
URL: <https://academy.hubspot.com/courses/digital-marketing>

Mapping of this Course with Programme Outcomes

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

Legend: 3 = Strongly Related 2 = Moderately Related 1 = Partially Related

PO–CO Justification (Digital Marketing Lab course)

Justification of Mapping of PO1 with All CO'S

PO1:CO1: Establishes conceptual understanding of digital marketing fundamentals.

PO1:CO2: Builds detailed knowledge of diverse marketing channels.

PO1:CO3: Applies conceptual knowledge to strategic planning.

PO1:CO4: Strengthens understanding of analytical and performance tools.

PO1:CO5: Enhances awareness of theoretical and ethical frameworks.

PO1:CO6: Integrates theory with applied practices.

PO1:CO7: Develops conceptual flexibility to adapt to trends.

Justification of Mapping of PO2 with All CO'S

PO2:CO1: Connects theoretical learning to digital marketing practices.

PO2:CO2: Promotes practical knowledge of digital channels.

PO2:CO3: Develops ability to plan and execute marketing campaigns.

PO2:CO4: Demonstrates procedural understanding of analytics tools.

PO2:CO5: Applies ethical and legal principles in practice.

PO2:CO6: Implements techniques in real-world scenarios.

PO2:CO7: Adapts professional knowledge to emerging trends.

Justification of Mapping of PO3 with All CO'S

PO3:CO1: Encourages entrepreneurial awareness through marketing basics.

PO3:CO2: Applies marketing channels to business growth.

PO3:CO3: Develops strategic thinking for entrepreneurship.

PO3:CO4: Analyses data for entrepreneurial decision-making.

PO3:CO5: Promotes responsible business ethics.

PO3:CO6: Integrates creativity with market-focused strategy.

PO3:CO7: Adapts entrepreneurial ideas to technological shifts.

Justification of Mapping of PO4 with All CO'S

PO4:CO1: Enhances analytical understanding of marketing frameworks.

PO4:CO2: Applies analytical skills to manage digital platforms.

PO4:CO3: Strengthens campaign planning and management.

PO4:CO4: Builds expertise in interpreting analytics data.

PO4:CO5: Demonstrates professionalism and ethical judgment.

PO4:CO6: Applies technical and leadership skills in campaign creation.

PO4:CO7: Demonstrates adaptability and leadership in evolving contexts.

Justification of Mapping of PO5 with All CO'S

PO5:CO1: Applies theoretical principles to practical marketing problems.

PO5:CO2: Analyzes and optimizes marketing strategies.

PO5:CO3: Demonstrates creativity and reasoning in decision-making.

PO5:CO4: Uses analytics for problem-solving in campaigns.

PO5:CO5: Evaluates legal and ethical problems effectively.

PO5:CO6: Measures campaign performance through data-driven reasoning.

PO5:CO7: Enhances critical thinking and adaptability.

Justification of Mapping of PO6 with All CO'S

PO6:CO1: Involves basic communication of marketing concepts.

PO6:CO2: Encourages effective presentation of strategies.

PO6:CO3: Promotes teamwork in campaign execution.

PO6:CO4: Communicates analytical findings effectively.

PO6:CO5: Promotes ethical and transparent communication.

PO6:CO6: Involves client and team collaboration.

PO6:CO7: Encourages adaptability in communication for new trends.

Justification of Mapping of PO7 with All CO'S

PO7:CO1: Introduces basic understanding of marketing analysis.

PO7:CO2: Promotes research of digital channels.

PO7:CO3: Encourages evidence-based marketing planning.

PO7:CO4: Applies tools like Google Analytics.

PO7:CO5: Promotes inquiry into ethical and legal frameworks.

PO7:CO6: Uses data to assess campaign outcomes.

PO7:CO7: Adapts research to market changes.

Justification of Mapping of PO8 with All CO'S

PO8:CO1: Encourages ongoing learning of marketing concepts.

PO8:CO2: Promotes self-learning of marketing platforms.

PO8:CO3: Encourages continuous improvement in digital strategy.

- PO8:CO4:** Involves learning advanced analytical tools.
- PO8:CO5:** Promotes ethical learning and reflection.
- PO8:CO6:** Reinforces adaptability and self-assessment.
- PO8:CO7:** Strengthens lifelong learning and adaptability.

Justification of Mapping of PO9 with All CO'S

- PO9:CO1:** Introduces basic digital marketing tools.
- PO9:CO2:** Applies digital technology across platforms.
- PO9:CO3:** Designs technology-driven campaigns.
- PO9:CO4:** Utilizes web analytics and measurement tools.
- PO9:CO5:** Uses digital media responsibly.
- PO9:CO6:** Employs digital tools for campaign analysis.
- PO9:CO7:** Adapts to evolving digital technologies.

Justification of Mapping of PO10 with All CO'S

- PO10:CO1:** Minimal multicultural relevance.
- PO10:CO2:** Partially engages global audiences.
- PO10:CO3:** Promotes awareness of diverse markets.
- PO10:CO4:** Limited link to multicultural elements.
- PO10:CO5:** Encourages inclusive and ethical marketing.
- PO10:CO6:** Minimal direct cultural impact.
- PO10:CO7:** Promotes empathy for consumer behaviour.

Justification of Mapping of PO11 with All CO'S

- PO11:CO1:** Encourages awareness of ethical marketing.
- PO11:CO2:** Promotes responsible online conduct.
- PO11:CO3:** Integrates ethical reasoning in strategy.
- PO11:CO4:** Promotes transparency in analytics.
- PO11:CO5:** Strongly upholds ethical and legal standards.
- PO11:CO6:** Promotes integrity in execution.
- PO11:CO7:** Encourages ethical adaptation to trends.

Justification of Mapping of PO12 with All CO'S

- PO12:CO1:** Encourages independent learning.
- PO12:CO2:** Promotes responsibility in managing platforms.
- PO12:CO3:** Strengthens independent campaign planning.
- PO12:CO4:** Promotes responsible data handling.
- PO12:CO5:** Reinforces accountability in compliance.
- PO12:CO6:** Demonstrates self-reliance in project outcomes.
- PO12:CO7:** Reflects accountability in adaptive strategies.

Justification of Mapping of PO13 with All CO'S

- PO13:CO1:** Minor relevance to social impact.
- PO13:CO2:** Limited connection to community awareness.
- PO13:CO3:** Promotes digital literacy and outreach.
- PO13:CO4:** Minimal direct relation.
- PO13:CO5:** Encourages social responsibility in ethics.
- PO13:CO6:** Supports community-based campaigns.
- PO13:CO7:** Applies marketing for societal benefit.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.B.A.
Programme Code	: BBA
Class	: S.Y.B.B.A.
Semester	: IV
Course Type	: Open Elective [Theory]
Course Code	: BCA-258-OE
Course Title	: Machine Learning for Business Administration
No. of Credits	: 02
No. of Teaching Hours	: 30

Prerequisites:

1. Math Basics – Probability, Statistics, Linear Algebra (at basic level).
2. Programming – Python (NumPy, Pandas), DBMS basics.

Course Objectives:

1. To understand the foundational concepts of Machine Learning and its distinction from AI and Data Science.
2. To explore supervised and unsupervised learning techniques and their business applications.
3. To apply ML models such as regression, decision trees, clustering, and association rules to solve real-world business problems.
4. To analyze and evaluate ML model performance using appropriate metrics.
5. To implement ML solutions across various business functions including marketing, finance, HR, and operations.
6. To utilize business analytics tools like Excel, Tableau, and Power BI for basic ML tasks.
7. To examine ethical issues, implementation challenges, and emerging trends in Machine Learning and AI for business.

Course Outcomes:

By the end of the course, students will be able to:

CO1: Explain the fundamental concepts of Machine Learning and distinguish it from AI and Data Science.

CO2: Classify and apply different types of Machine Learning techniques—supervised, unsupervised, and reinforcement learning—to business scenarios.

CO3: Build and evaluate predictive models such as regression, decision trees, and clustering for business analytics.

CO4: Use appropriate performance metrics (e.g., accuracy, precision, recall, RMSE) to assess ML models in business contexts.

CO5: Apply ML techniques to solve problems across various business functions, including marketing, finance, HR, and operations.

CO6: Demonstrate the use of tools like Excel, Tableau, and Power BI for basic ML applications and data visualization.

CO7: Evaluate ethical implications, implementation challenges, and emerging trends related to ML in business.

Topics and Learning Points

Unit 1: Introduction to Machine Learning Concepts (04 Lectures)

- 1.1 Meaning and importance of Machine Learning (ML) in today's business world
- 1.2 Relationship between AI, ML, and Data Science – in simple terms
- 1.3 Types of ML (Basic idea only): Supervised, Unsupervised, and Reinforcement Learning
- 1.4 Everyday examples of ML (YouTube recommendations, chatbots, voice assistants)
- 1.5 Role of ML in business decision-making

Unit 2: ML Techniques and Business Applications (10 Lectures)

- 2.1 Predictive analytics – how businesses use data to make predictions
- 2.2 Understanding regression and classification in simple terms (without formulas)
- 2.3 Customer segmentation and clustering (grouping customers by behavior)
- 2.4 Market Basket Analysis – product recommendation and cross-selling
- 2.5 Case studies: Sales forecasting, churn prediction, and marketing campaigns
- 2.6 Real-life business examples from Amazon, Netflix, banking, and HR

Unit 3: ML in Key Business Areas (08 Lectures)

- 3.1 Marketing: Target marketing, personalization, and customer retention
- 3.2 Finance: Risk prediction, fraud detection, and loan approvals
- 3.3 HR: Recruitment screening, employee performance, and attrition prediction
- 3.4 Operations: Inventory control and demand forecasting

Unit 4: Tools, Ethics, and Future of ML**(08 Lectures)**

4.1 Introduction to simple ML-friendly tools – Excel, Google Sheets, Power BI, Tableau (no coding)

4.2 Demonstrations of dashboards and data visualization

4.3 Ethical issues: Data privacy, fairness, and bias

4.4 Future trends: Chatbots, automation, AI in business, and career opportunities in ML

References:

1. Machine Learning in Business: An Introduction to the World of Data Science
John C. Hull
2. Machine Learning: Algorithms and Applications by Mohssen Mohammed,
Muhammad Badruddin Khan, Eihab Bashier
3. Building Machine Learning Powered Applications: Going from Idea to Product
Emmanuel Ameisen
4. Machine Learning Yearning by Andrew Ng
5. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking by Foster Provost & Tom Fawcett

Mapping of this Course with Programme Outcomes

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

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

PO1: A Fundamental Knowledge and Coherent Understanding

CO1: Provides a strong foundation by explaining core Machine Learning concepts and differentiating them from AI and Data Science, ensuring clear and coherent understanding.

- CO2:** Enhances fundamental knowledge through classification and application of various ML techniques to real business scenarios.
- CO3:** Builds on foundational knowledge by enabling students to develop and evaluate predictive models, deepening understanding of ML algorithms.
- CO4:** Strengthens conceptual clarity by teaching appropriate performance metrics to assess ML models effectively.
- CO5:** Applies fundamental ML principles to solve practical problems across diverse business functions, reinforcing core understanding.
- CO6:** Demonstrates foundational skills in using common analytical and visualization tools, supporting practical comprehension of ML applications.
- CO7:** Encourages critical reflection on ethical issues and trends, broadening the fundamental perspective of ML in a business context.

PO2: Procedural Knowledge for Skill Enhancement

- CO1:** Understanding foundational ML concepts and distinguishing it from AI/Data Science equips students with the procedural knowledge needed to initiate skill development in intelligent systems.
- CO2:** Applying diverse ML techniques to real-world business problems enhances procedural competence through hands-on experience and critical analysis.
- CO3:** Building and evaluating predictive models develops procedural fluency, enabling students to translate theory into practical skill sets for analytics tasks.
- CO4:** Using performance metrics to assess models sharpens procedural judgment in evaluating outcomes, a key component of skill enhancement.
- CO5:** Applying ML across business functions fosters procedural adaptability, improving students' ability to implement learned skills in varied domains.
- CO6:** Using industry tools like Excel, Tableau, and Power BI builds procedural familiarity, reinforcing practical ML application skills.
- CO7:** Evaluating ethical and implementation aspects nurtures critical procedural awareness, preparing students for responsible and sustainable ML practice.

PO3: Critical Thinking and Problem-Solving Skills:

- CO1:** Understanding core ML concepts encourages analytical thinking and helps differentiate between related fields, forming the basis for problem-solving in intelligent systems.
- CO2:** Applying appropriate ML techniques to various scenarios develops critical thinking and strategic decision-making in selecting the best approach to business problems.
- CO3:** Designing and evaluating models requires logical reasoning and problem-solving skills to interpret data patterns and optimize outcomes.
- CO4:** Selecting and interpreting the right performance metrics involves analytical thinking and the ability to evaluate model effectiveness critically.
- CO5:** Solving business problems using ML enhances practical problem-solving abilities across functional areas by applying tailored analytical solutions.
- CO6:** Using tools for ML applications and visualization strengthens critical thinking by enabling students to derive insights and solve problems using visual data representation.
- CO7:** Evaluating ethical issues and emerging trends cultivates a critical mindset and problem-solving orientation toward responsible and future-ready ML practices.

PO4: Professional Communication Skills:

- CO1:** Communicating the differences between ML, AI, and Data Science requires clear articulation of technical concepts, enhancing professional communication.
- CO2:** Explaining and justifying the choice of ML techniques for specific business scenarios fosters concise and effective communication.
- CO3:** Presenting and interpreting model outputs demands clarity in technical reporting and visual explanation, building communication proficiency.
- CO4:** Describing performance metrics and their relevance in evaluating ML models sharpens analytical and business communication skills.
- CO5:** Communicating ML-driven solutions across departments like HR, finance, or marketing strengthens cross-functional professional communication.
- CO6:** Explaining insights through visualization tools like Excel or Power BI enhances the ability to convey data-driven stories effectively.
- CO7:** Discussing ethical and implementation issues in ML applications requires structured argumentation and critical thinking in communication.

PO5: Analytical Reasoning Skills:

- CO1:** Understanding digital marketing concepts is foundational for designing systems; however, it does not directly involve system design and development techniques.
- CO2:** Identifying and analyzing visibility, engagement, and conversion metrics supports system functionality but is more focused on operational analysis than development.
- CO3:** Planning and structuring digital marketing campaigns directly involves design considerations, linking closely to the systematic approach in the development of systems.
- CO4:** Designing and developing websites is core as it involves applying systematic design processes to create functional and user-friendly systems.
- CO5:** Applying social media marketing strategies contributes to system design by informing user interaction, but it is less technical and more strategic in focus.
- CO6:** Creating and optimizing digital marketing campaigns involves systematic methods to ensure efficiency and effectiveness in design, closely aligning.
- CO7:** Developing comprehensive marketing strategies requires a systematic approach, making this outcome highly relevant to the principles of systems design development.

PO6: Innovation, Employability and Entrepreneurial Skills.

- CO1:** Understanding fundamental ML concepts builds a strong knowledge base that enhances employability. It also fosters innovative thinking by distinguishing ML from AI and Data Science in entrepreneurial contexts.
- CO2:** Applying different ML techniques to business scenarios improves problem-solving ability. This directly supports employability and opens entrepreneurial opportunities in data-driven industries.
- CO3:** Building predictive models equips learners with practical analytical skills in demand across industries. It fosters innovation by enabling data-driven decision-making for business ventures.

- CO4:** Using performance metrics to evaluate ML models prepares students to meet industry standards. Such assessment skills enhance employability by ensuring effective and reliable business solutions.
- CO5:** Applying ML techniques across business functions strengthens domain expertise for real-world use. This interdisciplinary application builds both employability and entrepreneurial problem-solving skills.
- CO6:** Demonstrating ML tools like Excel, Tableau, and Power BI increases practical tool proficiency. Such hands-on skills boost employability and enable innovative visualization-driven entrepreneurship.
- CO7:** Evaluating ethical implications and trends develops critical awareness of future business challenges. This ensures employability in responsible AI practices and fosters innovative entrepreneurial thinking.

PO7: Multidisciplinary Competence

- CO1:** Learning ML fundamentals alongside AI and Data Science develops interdisciplinary understanding. It builds competence by connecting computer science, statistics, and business applications.
- CO2:** Applying ML techniques to business problems shows integration across domains like finance, HR, and marketing. This enhances multidisciplinary skills by linking technology with management practices.
- CO3:** Building predictive models combines knowledge of mathematics, statistics, and business analytics. Such integration develops competence across multiple disciplines for data-driven solutions.
- CO4:** Using performance metrics draws upon statistical reasoning, computational methods, and business evaluation. This multidisciplinary approach ensures effective assessment of ML models.
- CO5:** Applying ML to diverse business functions demonstrates cross-domain adaptability. It strengthens multidisciplinary competence by linking data science with multiple organizational areas.
- CO6:** Demonstrating tools like Excel, Tableau, and Power BI merges technology, visualization, and business insights. This fosters competence in applying ML across technical and managerial disciplines.
- CO7:** Evaluating ethical and implementation issues in ML connects technology, law, and management perspectives. Such analysis builds multidisciplinary awareness for responsible innovation in business.

PO8: Value Inculcation through Community Engagement

- CO1:** Understanding an ML fundamental helps students recognize its role in addressing societal and community needs. It builds awareness of applying technology responsibly for community development.

- CO2:** Applying ML techniques to business and social scenarios can provide solutions to community challenges. This inculcates values of social responsibility through data-driven decision-making.
- CO3:** Building predictive models can be extended to community issues such as healthcare or education. Such applications foster value-driven engagement by solving real-life problems.
- CO4:** Using performance metrics ensures fairness, accuracy, and reliability of ML models. This supports community trust and inculcates values of accountability in technology use.
- CO5:** Applying ML across business functions encourages socially responsible solutions. It highlights how technology can improve community welfare through ethical business practices.
- CO6:** Demonstrating visualization tools builds transparency in data communication. This promotes community engagement by making ML insights accessible to non-technical stakeholders.
- CO7:** Evaluating ethical implications of ML emphasizes fairness, inclusion, and community well-being. It instils values of responsibility while engaging with society through technology.

PO9: Traditional Knowledge into Modern Application

- CO1:** Understanding ML fundamentals help transform conventional data analysis approaches into modern AI/ML applications. It bridges traditional knowledge systems with advanced computational methods.
- CO2:** Applying ML techniques to business mirrors the evolution of traditional decision-making into intelligent automation. This reflects the integration of old practices with modern machine learning strategies.
- CO3:** Building predictive models modernizes conventional forecasting methods used in business and analytics. It connects traditional statistical approaches with advanced ML techniques.
- CO4:** Using performance metrics aligns traditional measures of accuracy with modern model evaluation standards. This ensures continuity between old analytical practices and new applications.
- CO5:** Applying ML across functions modernizes traditional problem-solving in marketing, HR, finance, and operations. It shows how heritage practices can be strengthened by new ML tools.
- CO6:** Demonstrating BI tools like Excel, Tableau, and Power BI updates traditional reporting methods. This transition allows modern visualization to enhance older business practices.
- CO7:** Evaluating ethical and emerging trends integrates traditional human values with modern AI/ML applications. It ensures continuity of ethics while adopting new technological practices.

PO10: Design and Development of System

- CO1:** Understanding ML fundamentals provides the conceptual base required to design intelligent systems. It equips learners to integrate AI/ML principles into system development.
- CO2:** Applying supervised, unsupervised, and reinforcement techniques supports the design of data-driven systems. These methods form the backbone of modern intelligent applications.
- CO3:** Building predictive models contributes directly to system development in analytics and decision-making. It demonstrates the design of functional models for real-world business use.
- CO4:** Using performance metrics ensures that systems are designed for accuracy, efficiency, and reliability. This evaluation process refines system development for better performance.
- CO5:** Applying ML in business functions translates into designing domain-specific intelligent systems. It fosters innovation by developing systems that solve real organizational problems.
- CO6:** Demonstrating tools like Excel, Tableau, and Power BI aids in prototyping and system visualization. These tools support the practical development of business intelligence systems.
- CO7:** Evaluating ethical implications ensures that system design incorporates fairness, transparency, and accountability

PO11: Ethical and Social Responsibility

- CO1:** Understanding ML fundamentals helps students recognize the ethical limits of AI/ML use. It builds awareness of social responsibility while adopting modern technologies.
- CO2:** Applying ML techniques to business requires ethical consideration of fairness and bias. This foster socially responsible decision-making using machine learning.
- CO3:** Building predictive models demands accountability to avoid misuse or discrimination. It cultivates responsibility in ensuring models are used ethically in society.
- CO4:** Using performance metrics emphasizes transparency and fairness in evaluating models. This ensures socially responsible practices in ML deployment.
- CO5:** Applying ML in business functions highlights the need for responsible use of customer and employee data. It strengthens ethical practices across industries while solving problems.
- CO6:** Demonstrating BI tools involves ethical handling of data visualization and reporting. This builds responsibility to present data honestly and without manipulation.

CO7: Evaluating ethical implications directly fosters a culture of accountability in ML. It strengthens social responsibility in addressing emerging challenges and trends.

PO12: Research-Related Skills-

CO1: Understanding ML fundamentals help students recognize the ethical limits of AI/ML use. It builds awareness of social responsibility while adopting modern technologies.

CO2: Applying ML techniques to business requires ethical consideration of fairness and bias. This foster socially responsible decision-making using machine learning.

CO3: Building predictive models demands accountability to avoid misuse or discrimination. It cultivates responsibility in ensuring models are used ethically in society.

CO4: Using performance metrics emphasizes transparency and fairness in evaluating models. This ensures socially responsible practices in ML deployment.

CO5: Applying ML in business functions highlights the need for responsible use of customer and employee data. It strengthens ethical practices across industries while solving problems.

CO6: It is crucial for planning campaigns as it involves collaboration to integrate different marketing strategies.

CO7: Teamwork is important, the technical aspect of website development can be more individualistic.

PO13: Teamwork

CO1: This is foundational and relates to teamwork as group activities often involve discussions about the importance of concepts. Higher teamwork correlates with better understanding.

CO2: Analysis and brainstorming can enhance understanding of visibility and engagement levels, leading.

CO3: It is crucial for planning campaigns as it involves collaboration to integrate different marketing strategies.

CO4: Teamwork is important, the technical aspect of website development can be more individualistic.

CO5: Social media work can be collaborative, but often involves individual analysis and posting strategies.

CO6: Collaboration is essential in creating and optimizing campaigns.

CO7: This heavily relies on teamwork for gathering insights, brainstorming, and strategizing, thus the highest rating of is justified.

**CBCS Syllabus as per NEP 2020 for S.Y.B.C.A
(2024 Pattern)**

Name of the Programme	: B.C.A.
Programme Code	: BCA
Class	: S.Y.B.C.A.
Semester	: IV
Course Type	: Skill Enhancement Course (SEC) [Practical]
Course Code	: BCA-259-SEC
Course Title	: RDBMS Lab Course based on BCA-252-MRM
No. of Credits	: 02
No. of Teaching Hours	: 60

Course Objectives:

1. To learn the basics of PL/SQL blocks.
2. To understand control structures in PL/SQL.
3. To study the use of Views in databases.
4. To handle errors using exceptions in PL/SQL.
5. To learn how to create and use functions.
6. To write and use procedures in PL/SQL.
7. To use cursors and triggers for database operations.

Course Outcomes:

By the end of the course, students will be able to:

- CO1:** Write simple PL/SQL block programs.
- CO2:** Use IF, LOOP, WHILE, and FOR in PL/SQL.
- CO3:** Create and use Views in databases.
- CO4:** Apply exception handling in programs.
- CO5:** Develop and use PL/SQL functions.
- CO6:** Write and call PL/SQL procedures.
- CO7:** Work with cursors and triggers in PL/SQL.

Suggested Practical Assignments:

Assignment No.	Title of Experiment/ Practical
1	PL/SQL Basics
2	PL/SQL Blocks
3	Control Structure (IF)
4	Control Structure (LOOP)
5	Control Structure (WHILE)
6	Control Structure (FOR)
7	View
8	Exception Handling
9	PL/SQL Functions
10	PL/SQL Procedures
11	Cursors
12	Triggers
13	Case Study

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
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CO4	3	3	2	3	3	2	2	2	2	1	2	3	1
CO5	3	3	2	3	3	2	3	3	3	2	2	3	2
CO6	3	3	2	3	3	2	3	3	3	2	2	3	2
CO7	3	3	2	3	3	2	3	3	3	2	2	3	2

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

Justification of Mapping of PO1 with All CO'S

CO1: PO1: Writing simple PL/SQL block programs demonstrates strong understanding of foundational database programming concepts and methodologies.

CO2: PO1: Using IF, LOOP, WHILE, and FOR in PL/SQL shows strong knowledge of control structures and logical flow in programming.

CO3: PO1: Creating and using Views reflects strong understanding of relational database concepts and data abstraction principles.

CO4: PO1: Applying exception handling demonstrates strong comprehension of error management principles in database systems.

CO5: PO1: Developing and using PL/SQL functions shows strong grasp of modular programming and reusability concepts.

CO6: PO1: Writing and calling PL/SQL procedures reflects strong understanding of structured programming and database operation automation.

CO7: PO1: Working with cursors and triggers demonstrates deep knowledge of advanced PL/SQL features and their practical applications.

Justification of Mapping of PO2 with All CO'S

CO1: PO2: Writing simple PL/SQL block programs strongly develops practical coding skills applicable to real-world database tasks.

CO2: PO2: Using IF, LOOP, WHILE, and FOR in PL/SQL strongly enhances procedural knowledge and logic implementation in professional settings.

CO3: PO2: Creating and using Views demonstrates strong application of best practices in data abstraction and database design.

CO4: PO2: Applying exception handling strongly reflects professional capability to build robust and reliable database programs.

CO5: PO2: Developing and using PL/SQL functions strongly supports applying modular coding principles in practical scenarios.

CO6: PO2: Writing and calling PL/SQL procedures strongly enhances procedural programming and professional database management skills.

CO7: PO2: Working with cursors and triggers strongly develops advanced procedural expertise for real-world database operations.

Justification of Mapping of PO3 with All CO'S

CO1: PO3: Writing simple PL/SQL block programs partially supports innovative thinking by enabling basic automation skills useful in entrepreneurial contexts.

CO2: PO3: Using IF, LOOP, WHILE, and FOR in PL/SQL offers limited relation but develops logical structuring skills that can support creative solutions.

CO3: PO3: Creating and using Views moderately fosters innovative approaches to data presentation and business insight generation.

CO4: PO3: Applying exception handling moderately develops risk management skills by ensuring robust and reliable database operations.

CO5: PO3: Developing and using PL/SQL functions moderately supports innovative problem-solving and modular design for business applications.

CO6: PO3: Writing and calling PL/SQL procedures moderately encourages developing efficient, reusable solutions applicable to business projects.

CO7: PO3: Working with cursors and triggers moderately supports innovation in automating business processes and improving system efficiency.

Justification of Mapping of PO4 with All CO'S

CO1: PO4: Writing simple PL/SQL block programs moderately develops technical proficiency and problem-solving skills in database programming.

CO2: PO4: Using IF, LOOP, WHILE, and FOR in PL/SQL strongly enhances analytical and procedural problem-solving skills.

CO3: PO4: Creating and using Views strongly demonstrates technical competence in database design and data abstraction.

CO4: PO4: Applying exception handling strongly builds analytical and problem-solving skills for robust system design.

CO5: PO4: Developing and using PL/SQL functions strongly fosters specialized programming skills and modular solution design.

CO6: PO4: Writing and calling PL/SQL procedures strongly reflects technical skill and structured approach to database operations.

CO7: PO4: Working with cursors and triggers strongly develops advanced technical competencies and adaptability in database management.

Justification of Mapping of PO5 with All CO'S

CO1: PO5: Writing simple PL/SQL block programs moderately develops the ability to apply concepts and solve basic problems in database environments.

CO2: PO5: Using IF, LOOP, WHILE, and FOR in PL/SQL strongly enhances problem-solving skills and logical reasoning in practical scenarios.

CO3: PO5: Creating and using Views strongly develops analytical reasoning and the ability to apply database concepts to solve real-world problems.

CO4: PO5: Applying exception handling strongly improves capacity for identifying, analyzing, and resolving runtime problems.

CO5: PO5: Developing and using PL/SQL functions strongly supports applying modular logic to solve complex problems effectively.

CO6: PO5: Writing and calling PL/SQL procedures strongly enhances the ability to apply learned concepts in practical and structured ways.

CO7: PO5: Working with cursors and triggers strongly develops analytical reasoning and the ability to handle complex database scenarios.

Justification of Mapping of PO6 with All CO'S

CO1: PO6: Writing simple PL/SQL block programs moderately develops communication of logic and ideas through structured code.

CO2: PO6: Using IF, LOOP, WHILE, and FOR in PL/SQL moderately enhances ability to explain logic and collaborate on procedural solutions.

CO3: PO6: Creating and using Views moderately supports communication of data structure design and collaborative database work.

CO4: PO6: Applying exception handling moderately improves the ability to convey error management processes in collaborative settings.

CO5: PO6: Developing and using PL/SQL functions moderately promotes clarity in functional design communication and teamwork.

CO6: PO6: Writing and calling PL/SQL procedures moderately strengthens communication of modular solutions within team projects.

CO7: PO6: Working with cursors and triggers moderately enhances collaborative understanding of complex procedural implementations.

Justification of Mapping of PO7 with All CO'S

CO1: PO7: Writing simple PL/SQL block programs partially supports research skills by introducing basic procedural logic for data manipulation.

CO2: PO7: Using IF, LOOP, WHILE, and FOR in PL/SQL moderately fosters analytical thinking and methodology useful for research data processing.

CO3: PO7: Creating and using Views strongly supports research-related skills by enabling effective data abstraction and analysis.

CO4: PO7: Applying exception handling moderately contributes to research skills by ensuring reliable execution during data inquiry processes.

CO5: PO7: Developing and using PL/SQL functions strongly supports research methodology by enabling reusable and structured data operations.

CO6: PO7: Writing and calling PL/SQL procedures strongly enhances systematic approaches to research data management.

CO7: PO7: Working with cursors and triggers strongly supports observational and analytical skills needed for advanced data handling in research.

Justification of Mapping of PO8 with All CO'S

CO1: PO8: Writing simple PL/SQL block programs strongly develops self-directed learning by enabling independent practice and experimentation.

CO2: PO8: Using IF, LOOP, WHILE, and FOR in PL/SQL strongly promotes adaptive learning of control structures and logical reasoning.

CO3: PO8: Creating and using Views strongly enhances learning to manage data effectively and adapt to different project requirements.

CO4: PO8: Applying exception handling moderately supports self-learning of error management strategies in varied contexts.

CO5: PO8: Developing and using PL/SQL functions strongly fosters independent skill acquisition through modular and reusable code development.

CO6: PO8: Writing and calling PL/SQL procedures strongly builds autonomy in developing structured and maintainable database solutions.

CO7: PO8: Working with cursors and triggers strongly develops self-learning capabilities in advanced procedural database programming.

Justification of Mapping of PO9 with All CO'S

CO1: PO9: Writing simple PL/SQL block programs strongly develops digital skills by applying ICT tools for database programming.

CO2: PO9: Using IF, LOOP, WHILE, and FOR in PL/SQL strongly enhances technological problem-solving using programming constructs.

CO3: PO9: Creating and using Views strongly improves technological competence in organizing and retrieving data efficiently.

CO4: PO9: Applying exception handling moderately supports technological skills by ensuring robustness in software systems.

CO5: PO9: Developing and using PL/SQL functions strongly supports ICT proficiency through modular and reusable program design.

CO6: PO9: Writing and calling PL/SQL procedures strongly builds advanced technical skills for automated database operations.

CO7: PO9: Working with cursors and triggers strongly enhances technological skills in managing complex data workflows.

Justification of Mapping of PO10 with All CO'S

CO1: PO10: Writing simple PL/SQL block programs has minimal relation but can contribute to collaborative understanding in diverse teams.

CO2: PO10: Using IF, LOOP, WHILE, and FOR in PL/SQL partially supports clear communication of logic in a multicultural setting.

CO3: PO10: Creating and using Views moderately supports inclusive collaboration by organizing data access for diverse user needs.

CO4: PO10: Applying exception handling minimally relates to multicultural competence, mainly by promoting reliability and trust in shared systems.

CO5: PO10: Developing and using PL/SQL functions moderately supports collaborative work by enabling standardized solutions across diverse teams.

CO6: PO10: Writing and calling PL/SQL procedures moderately promotes cooperation through structured and shared database operations.

CO7: PO10: Working with cursors and triggers moderately supports team-based projects requiring coordinated database processes.

Justification of Mapping of PO11 with All CO'S

CO1: PO11: Writing simple PL/SQL block programs partially supports ethical coding by encouraging disciplined programming practices.

CO2: PO11: Using IF, LOOP, WHILE, and FOR in PL/SQL has limited relation but encourages careful logic design, which reflects responsibility.

CO3: PO11: Creating and using Views moderately supports value inculcation by promoting responsible data access and management.

CO4: PO11: Applying exception handling moderately relates to ethical responsibility by ensuring error-free and reliable system operations.

CO5: PO11: Developing and using PL/SQL functions moderately fosters ethical programming through reusability and maintainability.

CO6: PO11: Writing and calling PL/SQL procedures moderately supports responsible coding and systematic data handling.

CO7: PO11: Working with cursors and triggers moderately promotes ethical use of automation and efficient resource management in databases.

Justification of Mapping of PO12 with All CO'S

CO1: PO12: Writing simple PL/SQL block programs strongly develops autonomy by enabling independent creation and testing of code.

CO2: PO12: Using IF, LOOP, WHILE, and FOR in PL/SQL strongly enhances responsibility and accountability through structured control of program logic.

CO3: PO12: Creating and using Views strongly supports autonomy and accountability by allowing independent and efficient data management.

CO4: PO12: Applying exception handling strongly fosters accountability by ensuring programs handle errors reliably and responsibly.

CO5: PO12: Developing and using PL/SQL functions strongly promotes autonomy and responsibility in creating reusable and maintainable code.

CO6: PO12: Writing and calling PL/SQL procedures strongly enhances independence in project development and responsible system management.

CO7: PO12: Working with cursors and triggers strongly develops autonomy and accountability in handling advanced database operations effectively.

Justification Mapping of PO13 with All CO'S

CO1: PO13: Writing simple PL/SQL block programs has minimal relation but can contribute to community projects through basic automation.

CO2: PO13: Using IF, LOOP, WHILE, and FOR in PL/SQL partially supports collaborative coding for community-based database solutions.

CO3: PO13: Creating and using Views moderately supports community engagement by enabling organized data sharing for group projects.

CO4: PO13: Applying exception handling has limited relation but promotes reliability in collaborative systems serving communities.

CO5: PO13: Developing and using PL/SQL functions moderately supports community projects by enabling reusable, shared solutions.

CO6: PO13: Writing and calling PL/SQL procedures moderately fosters collaboration in developing structured database applications for community needs.

CO7: PO13: Working with cursors and triggers moderately supports community service projects by automating and improving database workflows.
