

**Syllabus and Course Structure of  
Bachelor of Computer Application  
BCA/BCA (Hons.)**

**2025-26**



**Birla School of Applied Sciences**

**Birla Global University**

**Bhubaneswar**

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## **Vision**

To be a premier educational institution in the field of computer applications, providing global knowledge and skills to students while promoting excellence, innovation, and inclusiveness.

## **Mission**

To provide a transformative educational experience to students, nurturing their intellectual, personal, and professional growth in the field of computer applications. We aim to achieve this by:

- Offering a comprehensive and rigorous curriculum that prepares students for the challenges of the modern technological world
- Encouraging creativity and innovation in learning and research
- Providing opportunities for international collaborations and exchange programs to broaden students' horizons
- Fostering a culture of diversity, inclusiveness, and respect for all individuals
- Continuously innovating our pedagogy and course content to meet the evolving needs of the industry
- Encouraging teamwork and collaboration among students and faculty for knowledge creation, acquisition, and dissemination.

## **Objective of the program:**

1. Develop a deep understanding of computer science and its applications in real-world contexts, including programming languages, data structures and algorithms, computer networks, databases, and software engineering.
2. Gain practical experience in software development, including designing, implementing, and testing software systems, using various tools and technologies commonly used in the industry.
3. Build critical thinking and problem-solving skills to tackle complex challenges in the field of computer science and develop innovative solutions using cutting-edge technologies.
4. Develop effective communication, collaboration, and teamwork skills to work effectively in a diverse and interdisciplinary environment.
5. Acquire knowledge and skills in emerging areas of computer science such as artificial intelligence, machine learning, computer vision, cybersecurity, and big data analytics to keep up with the rapidly changing technological landscape. (*For 4 years' degree programme leading to degree with research*).

## **Name of the Programme**

Bachelor of Computer Applications

## **Description of the Programme**

The Bachelor of Computer Applications (BCA) program is designed to provide students with a comprehensive understanding of the field of computer science and its applications in various industries. BCA program incorporates the recently implemented National Education Policy (NEP) of 2020, which aims to transform the Indian education system and promote holistic development among students.

BCA program is structured to equip students with the necessary knowledge and skills in computer science, programming, software development, and information technology. It offers a blend of theoretical concepts and practical training, enabling students to apply their learning to real-world scenarios.

- The Programme will be of 3 or 4 years duration with multiple exit and entry options. Students of this Programme can exit after 1st year with a certificate, after 2nd year with an Advanced Diploma, after 3rd year with a Bachelor's Degree. After 4th year, a student can be awarded with Bachelor's Degree (Honors). Bachelor's Degree (Honors) with Research will be awarded, in case a student secures 75% and above in all semesters.
- Students will be given opportunities for multidisciplinary and interdisciplinary education through options to choose courses of their interests from other schools within the university.
- The total credits for 3-year BCA will be minimum 120 credits and that for 4-year BCA (Hons with Research) degree, the minimum credits will be 160.
- The relevant multidisciplinary courses are designed to address the learning interests of the students across the schools.
- 20% of the courses may be offered online from SWAYAM.
- Academic Bank of Credits (ABC) will be established to facilitate Transfer of Credits. The credits earned at various levels will get credited into a digitalized ABC. Students can use their earned credits to take admission in another institution to further continue their studies for the remaining year/s of their graduation.
- The Academic Calendar for this Programme of the university will be synchronized to allow students of a particular UG Programme to study a course or courses from another UG Programme to meet the credit requirement of a semester. The commencement and closure of semesters and examinations for UG Programme will

be planned in a uniform manner for declaration of results and awarding grades after a semester/year.

## **The Programme Highlights**

### **Program Highlights: Bachelor of Computer Applications (BCA) Program**

**6.1 Discipline-Specific Courses (Core Major Courses):** The BCA program places a strong emphasis on core major courses that form the foundation of computer science and applications. These courses provide in-depth knowledge and understanding of essential subjects such as programming languages, database management, software engineering, web development, data structures, algorithms, and computer networks. Students will engage in 20 core major courses, with each course consisting of 80 hours of instruction.

**6.2 Interdisciplinary Minor Courses (IDC):** The BCA program recognizes the importance of interdisciplinary learning and offers students the opportunity to explore other related fields. Through eight interdisciplinary minor courses, students can broaden their horizons and gain insights from areas such as mathematics, statistics, business management, or communication. Each IDC course involves 32 hours of instruction.

**6.3 Multidisciplinary Courses (MDC):** To develop a well-rounded skill set, the BCA program includes three multidisciplinary courses. These courses integrate knowledge and concepts from different disciplines, fostering critical thinking and problem-solving abilities. With nine hours of instruction for each MDC course, students gain a broader perspective and a holistic approach to problem-solving.

**6.4 Ability Enhancement Courses (AEC):** AEC courses are designed to enhance students' abilities and competencies beyond their core subject knowledge. In the BCA program, students will engage in three AEC courses, which focus on areas such as communication skills, logical reasoning, analytical thinking, and entrepreneurial skills. These courses consist of eight hours of instruction each.

**6.5 Skill Enhancement Courses (SEC):** In the rapidly evolving field of computer applications, it is essential for students to acquire industry-relevant skills. The BCA program offers three skill enhancement courses to help students develop specific technical skills in areas such as programming frameworks, software tools, data analytics, or cybersecurity. Each SEC course involves nine hours of instruction.

**6.6 Common Value-Added Courses (VAC):** The BCA program recognizes the importance of holistic development and incorporates three common value-added courses. These courses cover topics such as personality development, ethics, sustainability, and social responsibility. By participating in these courses, students cultivate a sense of social

consciousness and ethical decision-making. Each VAC course comprises six hours of instruction.

**6.7 Project and Internship:** Practical exposure is a vital component of the BCA program. Students will engage in a comprehensive project and internship module, which spans three units. This module provides hands-on experience and allows students to apply their knowledge and skills in real-world scenarios. The project and internship component consists of 16 weeks, ensuring students gain practical industry experience.

**6.8 Department Electives (DSE):** To cater to individual interests and specialization within the field of computer applications, the BCA program offers four department electives. These elective courses allow students to delve deeper into specific areas of computer science, such as artificial intelligence, mobile app development, cloud computing, or data science. The number of hours of instruction for each DSE course may vary based on the chosen elective.

By incorporating these diverse components into the BCA program, aim to provide students with a well-rounded education, equipping them with the necessary knowledge, skills, and practical experience to excel in the field of computer applications

### **Pedagogy for BCA Program:**

The Bachelor of Computer Applications (BCA) program adopts a student-centered and practical approach to learning, ensuring that students actively engage in the learning process and develop a strong foundation in computer science and applications. The pedagogy is designed to be simple yet effective, promoting holistic development and preparing students for successful careers in the field of computer applications.

- **Interactive Classroom Sessions:** The program fosters interactive classroom sessions where students actively participate in discussions, ask questions, and engage in problem-solving exercises. The faculty encourages student involvement and creates a supportive learning environment.
- **Hands-on Lab Sessions:** Practical sessions in well-equipped computer labs are an integral part of the BCA program. Students get hands-on experience with programming languages, software development tools, and other technologies. Lab exercises and projects allow them to apply theoretical concepts and gain practical skills.
- **Case Studies and Real-world Examples:** The pedagogy includes the use of case studies and real-world examples to demonstrate the application of concepts. By analyzing real-life scenarios and exploring practical solutions, students develop critical thinking and problem-solving skills.
- **Project-based Learning:** The BCA program incorporates project-based learning, where students work on individual or group projects that simulate real-world scenarios. This approach

enhances their teamwork, communication, and project management abilities while applying their knowledge to solve complex problems.

- **Industry Interaction:** The program encourages industry interaction through guest lectures, workshops, and industry visits. Professionals from the IT industry share their experiences, insights, and current trends, giving students a glimpse into the practical aspects of the field.
- **Internships and Practical Training:** The BCA program emphasizes internships and practical training opportunities. Students have the chance to work with industry partners, gaining hands-on experience, and applying their skills in real work environments. This exposure enhances their understanding of industry practices and prepares them for future employment.
- **Continuous Assessments:** Regular assessments, including quizzes, assignments, and presentations, help evaluate students' progress and understanding of the subject matter. Feedback is provided to guide their learning and address any gaps in understanding.
- **Technology Integration:** The program leverages technology as a learning tool. Online resources, educational software, and virtual labs are utilized to enhance students' understanding of concepts and provide additional learning opportunities.
- **Mentoring and Guidance:** Faculty members act as mentors, providing individual guidance and support to students. They assist in setting academic goals, clarifying doubts, and offering career advice to ensure students' overall growth and success.
- **Collaborative Learning:** The BCA program promotes collaborative learning through group projects, discussions, and peer-to-peer interactions. Students learn from each other, exchange ideas, and develop teamwork and communication skills.

The pedagogy of the BCA program aims to create a dynamic and engaging learning environment, enabling students to acquire theoretical knowledge, practical skills, and a problem-solving mindset. By incorporating these simple yet effective teaching strategies, the program equips students with the necessary competencies to thrive in the field of computer applications.

### **Three Year BCA Programme:**

The total credits for 3-year BCA will be minimum 120. Following types of courses will be offered for a 3-Year BCA Programme.

- 15 Discipline-specific Major Courses (60 credits)
- 6 Interdisciplinary Minor Courses (24 credits including 12 credit of Vocational Education & Training)
- 3 Multidisciplinary Courses (9 credits)
- 3 Ability Enhancement Courses (8 credits)
- 3 Skills Enhancement Courses (9 credits)
- 3 Value-added Courses (6 credits)
- 1 Internship (2 credits)
- 1 Community Engagement Project (2 credits)

## **Four Year BCA (Hons./ Hons. with Research) Programme**

The 4-year BCA (Hons with Research) degree will be minimum 160. Following types of courses will be offered for a 4-Year BCA(H) Programme:

- 20 Discipline-specific Major Courses (80 credits)
- 8 Interdisciplinary Minor Courses (32 credits)
- 3 Multidisciplinary Courses (9 credits)
- 3 Ability Enhancement Courses (8 credits)
- 3 Skill Enhancement Courses (9 credits)
- 3 Value-added courses (6 credits)
- 1 Internship (2 credits)
- 1 Community Engagement Project (2 credits)
- 1 Research Project with Dissertation (12 credits)

## **Outcome Based Approach to Education (OBE)**

As per the National Higher Education Qualification Frameworks (NHEQF), students are expected to possess the quality & characteristics of the graduate of a Programme of the study, including learning outcomes relating to the disciplinary areas, learning generic outcomes that are expected to be acquired by a graduate on completion of the Programme.

OBE is an educational model that forms the base of a quality education system. There is no specified style of teaching or assessment in OBE. All educational activities carried out in OBE should help the students to achieve the set goals. The faculty may adapt the role of an instructor, trainer, facilitator, and/or mentor based on the outcomes targeted. OBE enhances the traditional methods and focuses on what the institute provides to the students. It shows the success by making or demonstrating outcomes using statements 'able to do' in favour of students. It provides clear standards for observable and measurable outcomes.

## **Four Levels of Outcomes from OBE**

1. Programme Educational Objectives (PEOs)
2. Programme Outcomes (POs)
3. Programme Specific Outcomes (PSOs)
4. Course Outcomes (COs)

## Graduate Attributes

The graduate attributes include the learning outcomes that are specific to disciplinary areas relating to the chosen field(s) of learning within the broad multidisciplinary & interdisciplinary learning outcomes that graduates of all Programmes should acquire & demonstrate.

<b><u>Graduate Attributes</u></b>	
1.	Disciplinary Knowledge
2.	Critical Thinking & Problem Solving
3.	Creativity & Innovation
4.	Effective Communication
5.	Research-related skills
6.	Cooperation & Team Work
7.	Global/Multicultural Competence
8.	Ethics & Human Values
9.	Lifelong Learning
10.	Leadership Readiness
11.	Community Engagement & Social Responsibilities
12.	Digital literacy

## **Programme Educational Objectives (PEOs)**

Programme Educational Objectives (PEOs) are defined for the aspiring students about what they will achieve once they join the Programme. PEOs are about professional and career accomplishment after 3 or 4 years of graduation. PEOs are the written statements taken from different aspects like Knowledge, Skills & Ethics with focus on Career, Competency and Behaviour. Three PEOs are recommended for BCA(H) Programme

<b><u>Program Educational Objectives (PEOs):</u></b>	
<b>PEO1.</b>	Graduates of BCA program will have strong foundation in computer science and will be able to apply the knowledge in the real-world problem-solving.
<b>PEO2.</b>	Graduates of BCA program will have the ability to communicate effectively, work in teams, and adapt to changes in technology and environment.

<b>PEO3.</b>	Graduates of BCA program will have a strong sense of ethics and social responsibility, and will be able to contribute positively to the society.
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### **Programme Specific Outcomes (PSOs)**

A Programme outcome is broad in scope and defines what the students will be able to do at the end of the Programme. POs are defined line with the graduate attributes as specified in the UGC. POs are to be specific, measurable and achievable. In the syllabus book given to students, there is a clear mention of course objectives and course outcomes along with the CO-PO mapping matrix for all the courses.

<u><b>Programme Outcomes (POs):</b></u>	
<b>PO1</b>	<b>Disciplinary Knowledge:</b> Understand the concepts of core subjects and have the hands-on skills to demonstrate competency in the domain of computer science.
<b>PO2</b>	<b>Critical Thinking and Problem Solving:</b> Define, identify, analyze, design, interpret, evaluate, and provide the solution using computer domain knowledge.
<b>PO3</b>	<b>Global/Multicultural Competence:</b> Identify and analyse global demand for computer technologies to provide a solution to all.
<b>PO4</b>	<b>Research Related Skills:</b> Students will develop conceptual clarity and be enabled to analyze a situation and provide sustainable solutions.
<b>PO5</b>	<b>Leadership &amp; Teamwork:</b> The ability to perform effectively as a leader and perform excellently with a variety of teams in a multidisciplinary environment.
<b>PO6</b>	<b>Effective Communication:</b> Ability to communicate effectively with various stakeholders in the field of computer science
<b>PO7</b>	<b>Ethics and Human Values:</b> Perform ethical and professional practice by using computer technology.
<b>PO8</b>	<b>Community Engagement and Social Responsibilities:</b> Help the community and society grow an advanced health system, promote economic growth, and provide a sustainable solution to society.

### Program Specific Outcomes (PSOs)

<b><u>Program Specific Outcomes (PSOs)</u></b>	
<b>PSO1.</b>	Professionally skilled and trained in the field of computer science, they can solve complex, real-time problems, which help them grow personally and professionally.
<b>PSO2.</b>	Understanding modern computer technologies and their applications to solve complex and critical issues that benefit society and the environment.
<b>PSO3.</b>	Trained to perform effectively as an individual, a team, and as a team leader in a multidisciplinary environment using critical thinking skills.

Programme Specific Outcomes (PSOs) are statements that describe what the graduates of a specific Programme should be able to do. A list of 3 PSOs have been defined for the BCA(H) Programme.

### Mapping of PEOs with POs

<b>MAPPING OF PEO WITH PO</b>								
<b>PEO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>PEO1</b>	H	H	H	M	M	M	M	H
<b>PEO2</b>	H	H	L	M	M	L	M	H
<b>PEO3</b>	H	M	L	H	M	M	H	H
<b>PEO4</b>	H	M	L	L	M	H	L	H
<b>PEO5</b>	H	M	H	L	H	M	L	H

*Level of correlation: 3-High, 2-Medium, 1-Low*

### Category wise Credits

<b>Sl. No</b>	<b>Couse Name</b>	<b>Abbreviations</b>
<b>1</b>	Discipline Specific Courses -Core Major (Core) Course	CC
<b>2</b>	Multidisciplinary Course	MDC
<b>3</b>	Ability Enhancement Course	AEC
<b>4</b>	Skill Enhancement Course	SEC
<b>5</b>	Common Value-added Courses	VAC
<b>6</b>	Project /Internship	P/I
<b>7</b>	Department Electives	DSE

### Year and Credit distribution

LEVEL	CC	IDC	MDC	AEC	SEC	VAC	DSE	P/I	Total Credit
<b>SEM I</b>	7	4	3	3	0	3	0	0	<b>20</b>
<b>SEM II</b>	7	4	3	3	0	3	0	0	<b>20</b>
<b>SEM III</b>	8	4	3	2	4	0	0	0	<b>21</b>
<b>SEM IV</b>	11	4	0	0	4	0	0	0	<b>19</b>
<b>SEM V</b>	8	0	0	0	0	2	8	2	<b>20</b>
<b>SEM VI</b>	8	0	0	0	0	0	4	8	<b>20</b>
<b>TOTAL</b>	49	16	9	8	8	8	12	10	<b>120</b>
<b>BCA (HONORS)</b>									
<b>SEM VII</b>	16	4	0	0	0	0	0	0	<b>20</b>
<b>SEM VIII</b>	0	0	0	0	0	0	8	12	<b>20</b>
<b>TOTAL</b>	65	20	9	8	8	8	20	22	<b>160</b>
<b>BCA (HONORS WITH SPECIALIZATION IN AI/ML or DATA SCIENCE)</b>									
<b>SEM VII</b>	8	0	0	0	0	0	8	4	<b>20</b>
<b>SEM VIII</b>	0	0	0	0	0	0	12	8	<b>20</b>
<b>TOTAL</b>	57	16	9	8	8	8	32	22	<b>160</b>
<b>BCA (HONORS)WITH RESEARCH</b>									
<b>SEM VII</b>	4	4	0	0	0	0	12	0	<b>20</b>
<b>SEM VIII</b>	0	0	0	0	0	0	0	20	<b>20</b>
<b>TOTAL</b>	53	20	9	8	8	8	24	30	<b>160</b>

**Note:** 4-credit course that focuses on theory is split into 3-hour lectures and 1-hour tutorials every week. For programs that have 3 credits, 2 credits, and 1 credit, each credit requires 1 hour of class time per week.

Eligibility Criteria - The candidate should have passed +2 Examinations or its equivalent in any discipline from any recognized board with minimum 50% marks in aggregate. The selection would be based on the career and selection test with equal weightage.

## Bachelor of Computer Application (BCA) Course Structure (Based on NEP-2020)

<b>BCA- 1st Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-1001	Computer System Architecture	3	0	0	3
2	BCAT-1002	Mathematical Foundations	3	1	0	4
3	BCAT-1003	English Communication Skills	2	0	0	2
4	BCAT-1004	Problem Solving using C	3	0	0	3
5	BCAT-1005	Principles of Management	3	0	0	3
6	BCAT-1006	Health and Wellness	1	0	0	1
7	BCAT-1007	Environmental Science	2	0	0	2
8	BCAL-1003	English Communication Skill Lab	0	0	2	1
9	BCAL-1004	Problem Solving using C Lab	0	0	2	1
<b>Total Credit</b>						<b>20</b>

<b>BCA- 2nd Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
<b>1</b>	BCAT-2001	Data Structure using C	3	0	0	3
<b>2</b>	BCAT-2002	Probability and Statistics	3	1	0	4
<b>3</b>	BCAT-2003	Cyber Security	3	0	0	3
<b>4</b>	BCAT-2004	Object Oriented Programming Using Java	2	0	0	2
<b>5</b>	BCAT-2005	Indian Knowledge System (IKS)	3	0	0	3
<b>6</b>	BCAT-2006	French Language	3	0	0	3
<b>7</b>	BCAL-2001	Data Structure using C Lab	0	0	2	1
<b>8</b>	BCAL-2005	Object Oriented Programming Using Java Lab	0	0	2	1
<b>Total Credit</b>						<b>20</b>

<b>BCA- 3rd Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-3001	Python Programming	3	0	0	3
2	BCAT-3002	Database Management Systems	3	0	0	3
3	BCAT-3003	Corporate Communications	2	0	0	2
4	BCAT-3004	Financial Institution & Market	3	0	0	3
5	BCAT-3005	Artificial Intelligence	3	1	0	4
6	BCAT-3006	Computer Network	3	1	0	4
7	BCAL-3001	Python Programming Lab	0	0	2	1
8	BCAL-3002	Database Management Systems Lab	0	0	2	1
<b>Total Credit</b>						21

<b>BCA- 4th Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-4001	Data Mining	3	0	0	3
2	BCAT-4002	Design and Analysis of Algorithms	3	1	0	4
3	BCAT-4003	Operating Systems	3	0	0	3
4	BCAT-4004	Optimization Techniques	3	1	0	4
5	BCAT-4005	Internet and Web Technology	3	0	0	3
6	BCAL-4003	Data Mining Lab	0	0	2	1
7	BCAL-4005	Internet and Web Technology Lab	0	0	2	1
<b>Total Credit</b>						19

<b>BCA- 5th Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-5001	Machine Learning	3	0	0	3
2	BCAT-5002	Software Engineering	3	0	0	3
3	BCAT-5003	DSE-I	3	1	0	4
4	BCAT-5004	DSE-II	3	1	0	4
5	BCAL-5001	Machine Learning Lab	0	0	2	1
6	BCAL-5002	Software Engineering Lab	0	0	2	1
7	BCAT-5005	Social Responsibility and Community Engagement	0	0	4	2
8	BCAI -5006	Internship	0	0	4	2
<b>Total Credit</b>						20

<b>BCA- 6th Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-6001	Theory of Computation	3	1	0	4
2	BCAT-6002	Cloud Computing	3	0	0	3
3	BCAT-6003	DSE-III	3	1	0	4
4	BCAL-6002	Cloud Computing Lab	0	0	2	1
5	BCAS-6005	Seminar	0	0	4	2
6	BCAP-6004	Project	0	0	0	6
<b>Total Credit</b>			20			

- **Following Semesters are applicable for the 4 Year BCA (Hons.) Degree only**

<b>BCA- 7th Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-7001	Research Methodology	3	1	0	4
2	BCAT-7002	Data Visualization and Interpretation	3	0	0	3
3	BCAT-7003	Quantum Computing	3	1	0	4
4	BCAT-7004	Software Project Management	3	1	0	4
5	BCAT-7005	Cryptography and Network Security	3	1	0	4
6	BCAL-7002	Data Visualization and Interpretation Lab	0	0	2	1
<b>Total Credit</b>						20

<b>BCA- 8th Sem</b>						
Sl. No.	Subject Code	Subject Name	L	T	P	Credits
1	BCAT-8001	DSE-IV	3	1	0	4
2	BCAT-8002	DSE-V	3	1	0	4
3	BCAS-8003	Seminar/Research Report writing and presentation	0	0	4	2
4	BCAI-8004	Research Report/ Industrial Training				10
<b>Total Credit</b>						20

## Discipline Specific Electives

<b>Sl. No</b>	<b>Electives (DSE) Bucket - 3rd year</b>	<b>Electives (DSE) Bucket - 4th year</b>
<b>1</b>	Computer Vision	Parallel Computing
<b>2</b>	Mobile App Development	Advanced Computer Network
<b>3</b>	High Performance Computing	Distributed Systems
<b>4</b>	Internet of Things	Generative AI
<b>5</b>	Mobile Computing	Edge Computing
<b>6</b>	Embedded Systems	Soft Computing
<b>7</b>	Information Retrieval Systems	Quantum Computing
<b>8</b>	Cyber Security and Privacy	Drone Analysis
<b>9</b>	Mobile Application Management	Object Oriented System Designing using UML
<b>10</b>	Wireless Sensor Network	Software Testing

## First Year

### Semester -I

#### Computer System Architecture

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-28/29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	Computer System Architecture
<b>Course Code</b>	BCAT-1001
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"><li>1. Understand the basic organization of a computer system and its functional units</li><li>2. Analyze different number systems such as binary, decimal, octal and hexa, and apply arithmetic algorithms.</li><li>3. Examine memory hierarchy, CPU memory interaction, cache memory, and related mapping,</li><li>4. Evaluate different parallel processing techniques</li><li>5. Analyze characteristics of multiprocessors, interconnection structures, interprocessor arbitration, interprocessor communication</li></ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Students will be able to understand the functional units of a computer system and describe the instruction codes and cycles involved in computer instructions.</p> <p>CO2. Students will be able to perform arithmetic operations using different number systems</p> <p>CO3. Students will be able to explain the memory hierarchy and the interaction between CPU and memory</p> <p>CO4. Students will be able to describe parallel processing and pipelining, including arithmetic pipelining, instruction pipeline.</p> <p>CO5. Students will be able to evaluate the characteristics of multiprocessors, including interconnection structures, interprocessor arbitration, interprocessor communication, and synchronization</p>

## Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	Basic Computer Organization: functional units of computer system, Instruction codes, Computer instructions, Instruction Cycles	CO1
<b>UNIT2</b>	Computer Arithmetic: Number System (Binary, Decimal, Octal, Hexa) Addition & Subtraction, Multiplication Algorithms, Division Algorithms, Booth Algorithm	CO2
<b>UNIT3</b>	Memory and system organization — Memory hierarchy CPU memory interaction – Organization of memory modules – Cache memory and related mapping	CO3
<b>UNIT4</b>	Parallel processing, Pipelining, Arithmetic pipelining, Instruction pipeline, RISC pipeline, Vector processing, Memory interleaving, Array processor, multiprocessor.	CO4
<b>UNIT5</b>	Characteristics of multiprocessors, Interconnection structures, Interprocessor arbitration, Interprocessor communication & synchronization., RISC,CISC;	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Mano, M. (2017). Computer System Architecture.
2. Stallings, W. (2016). Computer Organization & Architecture. PHI.
3. Hayes, J. P. (2016). Computer Architecture and Organization. McGraw Hill.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2	1							1		
CO2		1							1		
CO3	2								1		
CO4	1			1					1		
CO5		1							1		

## Mathematical Foundations

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	Mathematical Foundations
<b>Course Code</b>	BCAT-1002
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To make the students understand the basic concepts of some Mathematical topics related to different branch of Applied Sciences (e.g. Data &amp; Computer Science).</li> <li>2. To give insights about the applications of those Mathematical topics in different branch of Applied Sciences.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Describe and interpret the concept of set theory, functions, matrices, linear equations, differentiation and integration.</p> <p>CO2. Apply the concept and techniques of matrices and system of linear equations in the different branch of applied sciences that requires such concepts.</p> <p>CO3. Describe the differentiation and integration and its uses.</p> <p>CO4. Interpret the applicability of Multivariable Calculus and its terms to apply in real words</p> <p>CO5. Develop an understanding on the concepts of Graph theory.</p>

### Course Outline

Unit	Description	CO Mapping
<b>UNIT 1</b>	<b>Set and Functions</b> Concepts of set theory, Set operations, Cardinality, Subset, Power set, Infinite set. Functions – Domain and Range, One-to-one and onto functions, Characteristic functions, Inverse Functions, Compositions of Functions, Linear and Quadratic functions, Some Special Functions.	CO1
<b>UNIT 2</b>	<b>Matrices</b> Matrices: Matrices and Types, Operations on Matrices, Determinant of a Square Matrix, Inverse of a Square Matrix, Rank of a Matrix, Elementary transformations, Row - reduced Echelon form, Gaussian/Gauss-Jordan elimination, Matrix inversion, Solving system of linear equations, Eigenvalues, Eigenvectors, Rank of a matrix, Cayley - Hamilton theorem.	CO2

<b>UNIT 3</b>	<b>Differential and Integral Calculus</b> Differentiation and derivatives: Derivative, Basic laws of derivative, Successive differentiation (Chain rule), Leibnitz's Theorem, Concavity, Convexity, Maxima and minima of functions of single variables. Integral Calculus: Integral, Integration by parts, Beta and Gamma functions: definition and properties.	CO3
<b>UNIT 4</b>	<b>Multivariable Calculus</b> Functions of several variables, Limit, Continuity, Partial derivatives, Euler's theorem for homogeneous functions, Composite function and the Chain rules, Jacobian, Total derivatives, Maxima – Minima.	CO4
<b>UNIT 5</b>	<b>Introduction to Graph Theory</b> Graphs, Paths, Cycles, Euler and Hamilton graphs, Connectivity, Adjacency matrix, Incidence Matrix. Planar graphs, Colouring graphs (k-Colouring).	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Strang, G. (2017). Calculus (3rd Ed.). Wellesley-Cambridge Press.
2. Apostol, T.M. (2014). Calculus, Volume 1: One-Variable Calculus with an Introduction to Linear Algebra (2nd Ed.). Wiley India.

**Reference Books:**

1. H.R., K. (1999). Discrete Mathematics and its Applications. McGraw-Hill.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	1	2	-	-	-	-	-	-	-	2	-
CO2	-	-	-	-	-	-	-	1	-	-	1
CO3	-	-	-	1	-	1	-	-	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-
CO5	-	-	1	1	-	-	-	-	1	-	-

## English Commination skills

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	English Commination skills
<b>Course Code</b>	BCAT-1003
<b>Credit</b>	L-T-P- 2-0-0 Total Credit - 2
<b>Course Type</b>	AEC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To expose the students with communicative English as a tool for making professional career.</li> <li>2. To expose the students with various skills sets by sensitizing them to the dynamics of body language.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Acquire correct usage of communicative English through vocabulary building, grammar and pronunciation.</p> <p>CO2. Improve good listening skills.</p> <p>CO3. Learning the phonetic alphabet</p> <p>CO4. Strengthen ability to be creative in written communication.</p> <p>CO5. Increase reading speed and comprehension</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT 1</b>	<b>Remedial Grammar</b> Identifying and rectifying common errors: Subject-verb agreement, Parts of Speech, Word choice, Vocabulary Building	CO1
<b>UNIT 2</b>	<b>Listening Skills</b> Listening Skills: Importance and types of Listening; The sounds of English, The International	CO2
<b>UNIT 3</b>	Phonetic Alphabet (IPA); Vowels, diphthongs, consonants, consonant clusters; phonemic transcription; Syllable division and word stress; sentence rhythm and weak forms, contrastive stress Intonation: falling, rising and falling-rising tunes	CO3
<b>UNIT 4</b>	<b>Reading and Writing Skills</b> Reading Comprehension, Types of Reading; Paragraph writing, Letter writing, Descriptive and Concise Writing.	CO4

<b>UNIT 5</b>	<b>Speaking Skills</b> Situational Speaking, Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Power Point Presentation, Group Discussion; Public Speaking	CO5
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**Evaluation:**

Mode of Evaluation	Laboratory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

**Text Books:**

1. Murphy, R. (2017). English Grammar in Use (4th ed.). Cambridge UP.
2. Balasubramanian, T. (2017). A Textbook of English Phonetics for Indian Students. [Publisher].

**Reference Books:**

1. Kumar, S., & Lata, P. (2015). Communication Skills (2nd ed.). Oxford University Press.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	3	-	-	-	-	1
CO2	-	-	-	-	1	2	-	-	-	-	1
CO3	-	-	1	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	1	-	-	1
CO5	-	-	-	-	-	1	-	-	-	-	1

**Problem Solving using C**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	Problem Solving using C
<b>Course Code</b>	BCAT-1004
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	SEC
<b>Course Objective</b>	The subject aims to provide the student with:

	<ol style="list-style-type: none"> <li>1. An understanding of basic concepts of computer programming.</li> <li>2. An introduction to the fundamentals of C language.</li> <li>3. An understanding of problem-solving programs.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Define and explain algorithm and flowcharts</p> <p>CO2. Understand looping and explain the working and implementation of Array.</p> <p>CO3. Demonstrate the benefits and use of Functions and Pointers.</p> <p>CO4. Explain the working File.</p> <p>CO5. Explain Sorting and Searching Techniques.</p>

## Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<p><b>Introduction to Programming</b></p> <p>Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Algorithm /Flowcharts / Pseudocode, Generation of Programming Languages. Introduction to Language: Structure of C Program, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types in C, variables, constants, input/output statements in C. Operators and Expressions</p>	CO1
<b>UNIT2</b>	<p><b>Control Structure and Array</b></p> <p>Conditional Branching: if, if else and else if ladder and switch, Iteration and loops: Iterative statements, nested loops, break and continue statements. Arrays &amp; Strings: One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array:</p>	CO2
<b>UNIT3</b>	<p><b>Function and Pointer</b></p> <p>Function: Declaration, Definition, Call and return, call by value, Call by reference, Scope of variables, Storage classes, Recursive functions, Recursion vs Iteration. Example programs, such as Finding Factorial, Fibonacci series.</p> <p>Pointers: Idea of pointers, Defining pointers, Use of Pointers in Inter-function communication via arrays, matrices. Reading, writing and manipulating Strings, understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers. Dynamic memory allocation: Memory Layout Implicit vs. Explicit Allocation; Static vs. Dynamic Allocation; Motivation for Dynamic Allocation.</p>	CO3
<b>UNIT4</b>	<p><b>Structure and File</b></p> <p>Structure: Structures, Defining structures and Array of Structures, Structure vs Union, Pre-processor and Storage classes, File handling: ASCII and binary Files, command line arguments.</p>	CO4
<b>UNIT5</b>	<p><b>Searching and Sorting</b></p> <p>Introduction to searching and sorting, Linear search, Binary search, selection sort, Bubble sort.</p>	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Forouzan, B. A., & Gilberg, R. F. (2007). A Structured Programming Approach Using C (3rd ed.). Cengage Publication.
2. Kernighan, B. W., & Ritchie, D. M. (2015). The C Programming Language (2nd ed.). Prentice Hall of India

**Reference Books:**

1. Gottfried, B. (2017). Schaum's Outline of Programming with C (3rd ed.). McGraw-HillBook.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	-	2	-	1	2	2	1
CO2	2	2	-	-	-	-	-	-	2	1	-
CO3	2	2	-	-	-	-	-	-	2	1	-
CO4	1	1	-	-	1	-	-	-	2	1	-
CO5	2	2	-	-	-	-	-	1	2	1	-

**Principle of Management**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	Principle of management
<b>Course Code</b>	BCAT-1005
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. To enable student, understand the evolution management studies</li> <li>2. To help students to understand the roles challenges, and opportunities of an organization</li> </ol>

	<p>3. To help students understand the fundamentals of management process: planning, organizing, leadership and control from an organizational viewpoint</p> <p>4. This course will be an introduction to enable students to understand and develop managerial thinking.</p>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Describe and communicate the management evolution and how it will affect future managers.</p> <p>CO2. Conceptually explain the fundamental terminology and frameworks in the four functions of management: planning, organizing, leading and controlling;</p> <p>CO3. Analyse organizational case situations in different functions of management.</p> <p>CO4. Identify appropriate management techniques that are used in managing contemporary organizations.</p> <p>CO5. Evaluate leadership styles to anticipate the consequences of each leadership style. Analyse both qualitative and quantitative information to isolate issues and formulate best control methods.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	Meaning and definition of management. The role of managers the evolution of management the origins of management, Scientific management, Human relations management, Operations, information, systems, and contingency management. Organizational Environments and Cultures A. External environments B. Internal environments C. Ethics and social responsibility. Roles - Levels of Management –Types of Business Organization	CO1
<b>UNIT2</b>	Nature and Purpose - Formal and Informal Organization - Organization Chart - Structure and Process - Departmentation by different Strategies - Line and Staff Authority - Benefits and Limitations - De-Centralization and Delegation of Authority - Introduction to Human Resource management.	CO2
<b>UNIT3</b>	Nature and Purpose - Steps involved in Planning - Objectives - Setting Objectives - Types of Plan; Process of Managing by Objectives – Strategies - Policies and Planning Premises - Forecasting -Decision-Making	CO3
<b>UNIT4</b>	Human Factors - Creativity and Innovation - Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management Foundations of individual and group behaviour - Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment  Leadership: Concept, Definition, Leadership Styles, Leadership Theories Transactional and Transformational Leadership, Leadership development.	CO4

<b>UNIT5</b>	System and process of controlling – budgetary and non-budgetary; control techniques, Use of computers and IT in Management control - Productivity problems and management – control and performance – direct and preventive control – reporting.	CO5
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### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books

1. Robbins, S. P., & Coulter, M. (Year). Fundamentals of Management: Essential Concepts and Applications (9th ed.). Pearson Education.
2. R. Sivarethinamohan and P. Aranganathan, (2005) Principles of Management, 1<sup>st</sup> Edition, CBA/Tata McGraw -Hill Publishing Company Ltd.

### Reference Books

1. Stoner, J.A.F., Freeman, E., & Gilbert. (1995). Management (6th ed.). Pearson Education/Prentice Hall of India Pvt. Ltd.
2. Durbin. (2015). Essentials of Management (7th ed.). Cengage Learning India Pvt. Ltd.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	2	2	8	-	-	-	1
CO2					3			1			1
CO3				2							1
CO4		1	2								1
CO5				1	1	1	1	2		1	3

## Health and Wellness

<b>Course Name</b>	<b>Health &amp; Wellness</b>
<b>Course Code</b>	<b>1001</b>
<b>Course Credit</b>	<b>1 (10 L – 10 P)</b>
<b>Semester</b>	<b>I</b>
<b>Aims &amp; Objectives</b>	The course aims to help students manage stress, explain the importance of regular exercise - one that fits your life and that you will be likely to stick with.
<b>Course Outcomes</b>	At the end of this course the learner will be able to: <b>CO1:</b> Relate aerobic workouts for better cardiovascular health <b>CO2:</b> Select techniques for maximizing the exercise's benefits and Meditation <b>CO3:</b> Schedule exercises and Yoga a part of healthy lifestyle <b>CO4:</b> Adopt the right posture from ancient Yoga and planning for diet
<b>Course Outline</b>	<b>Unit I</b> <b>Introduction</b> Course overview, Exercise: What and how much? Creating your workout plan, A word about posture, Key terms you'll want to know, Safety first! <b>Unit II</b> <b>Basic Exercising</b> Getting Started with Cardio Exercise, workout with arm sweeps, workout with resistance bands, Chest punch, Sword pull, Two-handed pull down, Triceps pull, Biceps curl <b>Unit III</b> <b>Benefits of Exercise</b> Benefits of Exercise, exercise prevents cardiovascular disease, Exercise helps fight diabetes, What happens when you exercise? Basic Yoga from Home
<b>Evaluation</b>	<b>Continuous Internal Evaluation (CIE): 40 marks</b> <b>End Semester Evaluation (ESE): 60 marks</b>
<b>References</b>	<b>Text Book</b> H. Benson and E. Stuart (2021). The Wellness Book: The Comprehensive Guide to Maintaining Health and Treating Stress-Related Illness, Amazon <b>Other Readings</b> B.L. Seaward (2022). Health and Wellness Journal Workbook, Amazon

### Facilitating the Achievement of Course Outcomes

Sl. No	CO	Classroom Activities & Techniques	Assessment Method	Bloom's Taxonomy Level
CO1	Relate aerobic workouts for better cardiovascular health.	Case Study Approach	Mock Test and MCQ	1,2

CO 2	Select techniques for maximizing the exercise's benefits and Meditation	Essay Type Questions	Role Play	2, 3
CO 3	Schedule exercises and Yoga a part of healthy lifestyle	Exercise Charts	Cognitive Fitness Test	1,3,4
CO 4	Adopt the right posture from ancient Yoga and planning for diet	Project Assignment	Fitness Management Test	3, 4

**Bloom's Taxonomy:** Level 1: Remembering; Level 2: Understanding; Level 3: Applying; Level 4: Analysing; Level 5: Evaluating; Level 6: Creating

### Mapping of the Course Outcomes to the Program Outcomes (POs)

Course Outcomes (COs)	Program Outcomes (POs)									
	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PSO 1	PSO 2	PSO3
CO 1	1		3		3			2		2
CO 2		2	3	3			3	1	1	2
CO 3			3		2				1	2
CO 4		2	3			3		1		2
CO 5	2		3	2			3		1	1

### Assessment Pattern & Marks Distribution Continuous Internal Evaluation (CIE) 40 Marks

Bloom's Category	Presentation (10)	Writing Assignments (10)	Project Simulation (20)
Remember	5		
Understand			5
Apply	5	5	5
Analyze		5	5
Evaluate			
Create			5

### End Semester Evaluation (ESE) 60 Marks

Bloom's Taxonomy Level	Test Marks
Remember	5
Understand	15
Apply	20
Analyze	5
Evaluate	10
Create	5

## ENVIRONMENTAL STUDIES

<b>Course Name</b>	<b>ENVIRONMENTAL STUDIES</b>
<b>Course Code</b>	<b>1002</b>
<b>Course Type</b>	<b>Value-added Course</b>
<b>Course Credit</b>	<b>2 (1L, 1T)</b>
<b>Semester</b>	<b>I</b>
<b>Objectives</b>	The course aims to make the students aware of the importance of protection of environment and conservation of natural resources like land, water, forest and mines etc.
<b>Course Outcomes(COs)</b>	<p>At the end of this course the learner will be able to:</p> <p><b>CO 1:</b> Recognise the concepts and methodologies of social and environmental processes.</p> <p><b>CO 2:</b> Illustrate the roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.</p> <p><b>CO 3:</b> Demonstrate the importance of environmental resources.</p> <p><b>CO 4:</b> Examine the utility of environmental sources.</p> <p><b>CO-5:</b> Analyse the ecosystem and able to understand the different types of pollutions in country</p>
<b>Course Outline</b>	<p><b>Unit- I</b></p> <p><b>Introduction to environmental studies &amp; Ecosystems</b></p> <p>Multidisciplinary nature of environmental studies; components of environment, atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance</p> <p><b>Unit- II</b></p> <p><b>Natural Resources: Renewable and Non-renewable Resources</b></p> <p>Land Resources and land use change; Land degradation, soil erosion and Desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity, and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international &amp; inter-state).</p> <p><b>Unit- III</b></p> <p><b>Biodiversity and Conservation</b></p> <p>Levels of biological diversity: genetic, species and ecosystem diversity.</p>

	<p>Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation.</p> <p><b>Unit IV</b></p> <p><b>Environmental Pollution &amp; Environmental Policies &amp; Practices</b></p> <p>Environmental pollution: types, causes, effects and controls; Air, water, soil, chemical and noise pollution, Nuclear hazards and human health risks, Solid waste management: Control measures of urban and industrial waste. Pollution case studies.</p> <p><b>Unit- V</b></p> <p><b>Human Communities and the Environment</b></p> <p>Human population and growth: Impacts on environment, human health and welfares. Carbon footprint. Resettlement and rehabilitation of project affected persons, case studies. Disaster management: floods, earthquakes, cyclones and landslides.</p>
<b>Evaluation</b>	<p><b>Continuous Internal Evaluation (CIE) : 40 marks</b></p> <p><b>End Semester Evaluation (ESE): 60 marks</b></p>
<b>Pedagogy</b>	<p>Presentations</p> <p>Role plays</p> <p>Case-let Analysis</p>
<b>Suggested Readings:</b>	<p><b>Text Books:</b></p> <p>Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. Erach Bharucha, Environmental Studies, University Grants Commission</p> <p><b>Reference Books:</b></p> <p>Carson, R. (2002). <i>Silent Spring</i>, Houghton Mifflin Harcourt.</p> <p>Gadgil, M., &amp; Guha, R. (1993). <i>This Fissured Land: An Ecological History of India</i>. Univ. of California Press.</p> <p>Gleeson, B. &amp; Low, N. (eds.) (1999). <i>Global Ethics and Environment</i>. London, Routledge.</p>

### Facilitating the Achievement of Course Outcomes

Unit No.	Course Outcomes (CO)	Teaching and Learning Activity	Assessment Method
1	Recognise the concepts and methodologies of social and environmental processes	Class lectures, Audio visuals	Quiz
2	Illustrate the roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.	Lecture, presentation and activity. Topics for short term projects to be	Individual and team-based tasks, Project Reports

		given.	
3	Demonstrate the importance of environmental resources	Case discussions	Group Case Presentation,
4	Examine the utility of environmental sources.	Discussions, Research Project	Group Assignment, Research Reports.
5.	Analyse the ecosystem and able to understand the different types of pollutions in country	Field Visits	Visit Reports

Course Outcomes (CO)	Program Outcomes (POs)									
	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PSO1	PSO2	PSO3
CO 1			3		3			2		
CO 2		2		3			3	1	1	
CO 3	1				2				1	2
CO 4		2				3		1		2
CO 5	2		3	2			3		1	1

### Assessment Pattern & Marks Distribution

#### Continuous Internal Evaluation (CIE) 40 Marks

Bloom's Category	Presentation (10)	Writing Assignments (10)	Project Simulation (20)
Remember	5		
Understand			5
Apply	5	5	5
Analyze		5	5
Evaluate			
Create			5

#### End Semester Evaluation (ESE) 60 Marks

Bloom's Taxonomy Level	Test Marks
Remember	5
Understand	15
Apply	20
Analyze	5
Evaluate	10
Create	5

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1							3	2			1
CO2				2							1
CO3				1							1
CO4							1				1
CO5								1			1

### English Communication Skill Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	Communication Skill Lab
<b>Course Code</b>	BCAL-1003
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	AEC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To expose the students with communicative English as a tool for making professional career.</li> <li>2. To expose the students with various skills sets by sensitizing them to the dynamics of body language.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Acquire correct usage of communicative English through vocabulary building, grammar and pronunciation.</p> <p>CO2. Improve good listening skills.</p> <p>CO3. Learning the phonetic alphabet</p> <p>CO4. Strengthen ability to be creative in written communication.</p> <p>CO5. Increase reading speed and comprehension</p>

### Course Outline

Unit	Description	CO Mapping
Lab-1-2	Remedial Grammar	CO1

	Identifying and rectifying common errors: Subject-verb agreement, Parts of Speech, Word choice, Vocabulary Building	
<b>Lab-3-6</b>	Listening Skills Listening Skills: Importance and types of Listening; The sounds of English, The International Phonetic Alphabet (IPA); Vowels, diphthongs, consonants, consonant clusters; phonemic transcription; Syllable division and word stress; sentence rhythm and weak forms, contrastive stress Intonation: falling, rising and falling-rising tunes	CO2, CO3
<b>Lab-6-8</b>	Reading and Writing Skills Reading Comprehension, Types of Reading; Paragraph writing, Letter writing, Descriptive and Concise Writing.	CO4
<b>Lab- 9-12</b>	Speaking Skills Situational Speaking, Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Power Point Presentation, Group Discussion; Public Speaking	CO5

### Evaluation:

Mode of Evaluation	Laboratory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

### Text Books:

1. Murphy, R. (2017). English Grammar in Use (4th ed.). Cambridge UP.
2. Balasubramanian, T. (2017). A Textbook of English Phonetics for Indian Students. [Publisher].

### Reference Books:

2. Kumar, S., & Lata, P. (2015). Communication Skills (2nd ed.). Oxford University Press.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1			1			3			1		2
CO2					3			1			2
CO3						3					
CO4						2		1		2	
CO5					1	1					

## Problem Solving using C Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	I
<b>Course Title</b>	Problem Solving using C Lab
<b>Course Code</b>	BCAL-1004
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	SEC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Introduce the essential skills for a logical thinking to problem solving</li> <li>2. Introduce the essential skills in programming for problem solving using computer.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Use of environment, use the primitive data types and data structures of “C”.</p> <p>CO2. State and use of sequence control statements of “C”.</p> <p>CO3. Write programs functions (both in-built as well as user defined)</p> <p>CO4. Understand the usage of arrays, pointers, structure, and union in “C”.</p> <p>CO5. Understand the commands of File Management in “C” and implement it in program.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>Lab-1</b>	Familiarity with IDE Programs on arithmetic expressions, data type limits, operators and precedence.	CO1
<b>Lab-2</b>	Programs on Conditional Branching.	CO2
<b>Lab-3</b>	Programs on Loops.	CO2
<b>Lab-4</b>	Programs on single dimensional array. Programs on two-dimensional array.	CO2
<b>Lab-5</b>	Programs on String operations (with and without library functions)	CO2
<b>Lab-6</b>	Programs on Functions (including searching and sorting). Programs on Recursive Functions	CO3

<b>Lab-7</b>	Programs on Pointers. Programs on Dynamic Memory Allocation.	C04
<b>Lab-8 -9</b>	Programs on Structure & Union. Programs on File Handling	CO4, CO5
<b>Lab-10-12</b>	Programs on Searching and Sorting	CO2, CO3

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

**Text Books:**

- Forouzan, B. A., & Gilberg, R. F. (2007). A Structured Programming Approach Using C (3rd ed.). Cengage Publication.
- Kernighan, B. W., & Ritchie, D. M. (2015). The C Programming Language (2nd ed.). Prentice Hall of India

**Reference Books:**

- Gottfried, B. (2017). Schaum's Outline of Programming with C (3rd ed.). McGraw-HillBook.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2		1						2		
CO2		2							2	2	
CO3		1				1	1		3	2	
CO4	1	1		1					3		
CO5	1	2									1

**Semester -II**  
**Data Structure Using C**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	II
<b>Course Title</b>	Data Structure using C
<b>Course Code</b>	BCAT-2001
<b>Credit</b>	L-T-P- 2-0-0 Total Credit - 2
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. To provide the knowledge of basic data structures and their implementations.</li> <li>2. To understand importance of data structures in context of writing efficient programs.</li> <li>3. To develop skills to apply appropriate data structures in problem solving.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <ol style="list-style-type: none"> <li>CO1. Understand and apply the concept of Abstract Data Types (ADTs) for representing complex data structures such as rational numbers, stacks, queues, matrices, linked lists, and trees.</li> <li>CO2. Demonstrate proficiency in implementing various operations on data structures including insertion, deletion, traversal, and search for efficient and effective data processing.</li> <li>CO3. Analyze and compare the pros and cons of various tree representations such as adjacency matrix and adjacency list for solving real-world problems.</li> <li>CO4. Apply different sorting algorithms such as bubble sort, selection sort, quicksort, and merge sort for efficient data organization and retrieval.</li> <li>CO5. Design and implement basic graph algorithms such as Depth First Search and Breadth First Search for analyzing graphs and solving problems in areas such as social networks, transportation, and logistics</li> </ol>

**Course Outline**

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Abstract Data Types</b> Definition and Representation, ADT of rational number, ADT of Stack, Data Structure and ADT. Stack and its usages: reversing string, matching parentheses, in fix to postfix, decimal to binary	CO1

	number. Queue: linear & circular queue, Deque & Applications. Matrix – sparse and dense. Representation of sparse matrix, Transpose & addition of sparse matrices.	
<b>UNIT2</b>	<b>Linked list and its representation</b> using array, using self-referential structure. Singly, circular and double linked lists. Operations on linked list – Insertion, Deletion, Traversals. Usages of Linked list – insertion sort, Addition/multiplication of polynomials. Addition/Multiplication of large numbers.	CO2
<b>UNIT3</b>	<b>Tree</b> Definition and Terminologies, child and parent nodes, Sub tree, root, leaf node, internal node, height of a tree. Binary, ternary, quad tree. Binary tree traversals. Reconstruction of binary tree from traversals. Binary search tree – inserting a new key, deleting a key, searching a key. AVL tree – inserting a new key into an AVL tree using rotations. B- tree : insertion and deletion using node splitting and merging	CO3
<b>UNIT4</b>	<b>Sorting and Searching</b> Bubble sort, selection sort quick sort and merge sort. Linear and binary search, Fibonacci search.	CO4
<b>UNIT5</b>	<b>Basic Graph Algorithm</b> Graph representation – adjacency matrix and list – pros and cons. Graph traversals – Depth First Search and Breadth First Search.	CO5

**Evaluation:**

<b>Mode of Evaluation</b>	Theory	
<b>Weightage</b>	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Gilberg, R., & Forouzan, B. (2016). Data Structures: A Pseudocode Approach with C (2nd ed.). Cengage.
2. Kruse, R.L., & Leung, C. T. (2008). Data Structures and Program Design in C (2nd ed.). Pearson.

**Reference Books:**

1. Langsam, Y., Augenstein, M. J., & Tanenbaum, A. M. (2009). Data Structures Using C (3rd ed.). Pearson.
2. Mehlhorn, K., & Sanders, P. (2010). Algorithms and Data Structures: The Basic Toolbox. Springer.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2	2							1		
CO2		1								1	
CO3		1								1	
CO4		1		1					1		
CO5	1					1					

### Probability and Statistics

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	II
<b>Course Title</b>	Probability and Statistics
<b>Course Code</b>	BCAT-2002
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	IDC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To make students familiar with the concept of Probability and Statistics and display data by means of various tables, charts, and graphs.</li> <li>2. To learn different probability distribution functions, sampling distribution, large sample estimation and hypothesis testing and apply them to solve real-life problem.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1.Understand and apply Probability &amp; statistics problems into application part.</p> <p>CO2.Acquire knowledge on different probability distribution functions and its application.</p> <p>CO3.Learn and apply sampling distribution and large sample estimation into real-life problem.</p> <p>CO4.Implement Large Sample Tests of Hypothesis methods in solving the various problems.</p> <p>CO5.Learn efficient Probability &amp; statistics procedures to solve real life problem</p>

## Course Outline

Unit	Description	CO Mapping
UNIT1	Introduction: Probability and Probability Distribution: Events and the Sample Space, Calculating Probabilities using Simple events, Useful counting rules, Probability rules: Addition rule, Conditional probability and multiplication rule, Bayes' rule.	CO1,CO2
UNIT2	Probability Distributions: Random Variable, Discrete random variable, Mean and Standard deviation of discrete random variable, Discrete Probability Distributions: Binomial, Poisson and Hypergeometric probability distribution, Continuous Probability distribution: Normal distribution.	CO2
UNIT3	Sampling Distribution: sampling plans and Labal designs, Sampling distribution of a statistic, Central Limit theorem, Sampling distribution of the Sample mean and Proportion. Large Sample Estimation: Point estimation, Interval estimation, Confidence interval of population mean, Population proportion, difference between two population means, difference between two population proportions.	CO3, CO5
UNIT4	Large Sample Tests of Hypothesis: Test of a Population mean, Test of difference of two population means, Test of hypothesis for a binomial proportion, Test of hypothesis for the difference between two binomial proportions.	CO4, CO5
UNIT5	Inference from Small Samples: Student's t Distribution, Small Sample inferences concerning a population mean and difference between two population means, Inferences concerning a population variance and difference between two population variances.	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Mendenhall, W., Beaver, R. J., & Beaver, B. M. (Year). Introduction to Probability and Statistics (14th ed.). CENGAGE Learning.
2. 2Hines, W. W., Montgomery, D.C., Goldsman, D.M., & Borror, C.M. (Year). Probability & Statistics in Engineering. John Wiley & Sons.
3. Ross, S. (Year). First Course in Probability. Pearson Education.

CO	CORRELATION WITH PROGRAM OUTCOMES					CORRELATION WITH PROGRAM SPECIFIC OUTCOMES				
	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2		1					1		
CO2			1							
CO3						1	1		1	
CO4			1	1						
CO5	1					1				1

### Cyber Security

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	II
<b>Course Title</b>	Cyber Security
<b>Course Code</b>	BCAT-2003
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Understand the importance of cybersecurity and the impact of cyber-attacks on organizations and individuals.</li> <li>2. Recognize different types of cyber threats and attacks, such as malware, viruses, and ransomware, and understand how to mitigate them.</li> <li>3. Identify and evaluate various cybersecurity technologies and tools, including intrusion detection and prevention systems, security information and event management, endpoint protection tools, and vulnerability assessment and penetration testing.</li> <li>4. Develop information security policies and procedures, incident response planning and management, security awareness and training, and physical security considerations to ensure the security of organizational assets.</li> <li>5. Stay up-to-date with emerging cybersecurity threats and trends, advances in cybersecurity technologies, and ethical considerations in cybersecurity to ensure preparedness for the future.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the definition of Cybersecurity and the importance of protecting digital assets.</p>

	<p>CO2. Recognize various types of Cybersecurity threats and attacks, and apply risk management principles to assess and mitigate potential vulnerabilities.</p> <p>CO3. Explain basic Cryptography and encryption concepts, network security, firewalls, and identify security tools used in Cybersecurity.</p> <p>CO4. Develop Information Security policies and procedures, incident response planning, and management, and evaluate compliance with regulatory requirements.</p> <p>CO5. Analyze emerging Cybersecurity threats and trends, evaluate the latest Cybersecurity technologies, and understand ethical considerations in Cybersecurity.</p>
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**Course Outline**

Unit	Description	CO Mapping
<b>UNIT1</b>	<b>Introduction to Cybersecurity:</b> Definition of Cybersecurity ,Importance of Cybersecurity, Cybersecurity threats and attacks, Overview of Cybersecurity frameworks and standards ,Basic principles of Cybersecurity	CO1
<b>UNIT2</b>	<b>Network Security:</b> Fundamentals of network security, Types of network security threats, Network security protocols and technologies, Network security best practices	CO2
<b>UNIT3</b>	<b>Cybersecurity Technologies and Tools:</b> Intrusion detection and prevention systems (IDS/IPS), Security Information and Event Management (SIEM), Endpoint protection tools ,Vulnerability assessment and penetration testing, Security Operations Center (SOC) tools	CO3
<b>UNIT4</b>	<b>Cybersecurity Policies and Procedures:</b> Information security policies and procedures, Incident response planning and management, Security awareness and training, Physical security considerations, Compliance and regulatory requirements	CO4
<b>UNIT5</b>	<b>Future of Cybersecurity:</b> Emerging Cybersecurity threats and trends, Advances in Cybersecurity technologies, Ethical considerations in Cybersecurity	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Suggested Books:**

1. Ciampa, M. (2021). Security+ guide to network security fundamentals. Cengage Learning.

**Reference Books:**

1. Pfleeger, C. P., & Pfleeger, S. L. (2018). Security in computing. Pearson

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								2		
CO2		1	1							2	
CO3							1	1			
CO4				1	2			1			
CO5				2			1				2

### Object Oriented Programming using Java

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	II
<b>Course Title</b>	Object Oriented Programming using Java
<b>Course Code</b>	BCAT-2004
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Learn the syntax, semantics and idioms of the Java programming language.</li> <li>2. Gain confidence in object oriented programming principles through lots of practical exercises that provide useful exposure to the core Java class libraries.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the fundamentals of Java programming language and its environment, fundamental programming structures of Java, including Data Types, Variables, Keywords, Typecasting, Arrays, and Operators. Acquire knowledge of Java's Control Statements such as if, switch, iteration statement, while, do-while, for, Nested loop, and the concepts of Objects and Classes.</p> <p>CO2. Learn Inheritance and its types, including the use of the super keyword, Method overriding, Dynamic method</p>

	<p>Dispatch, and the use of Abstract Classes and Final with Inheritance.</p> <p>CO3. Gain a comprehensive understanding of Java's Multi-Threading concepts, String Handling, Java I/O, Wrapper Classes,</p> <p>CO4. Understanding the concept of wrapper classes, frameworks and connecting concept of data base</p> <p>CO5. Collection Framework, Database, Event Handling, AWT, and Swing, including their classes, interfaces, and components.</p>
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### Course Outline

Unit	Description	CO Mapping
UNIT1	<p><b>Introduction to Java and Java programming Environment.</b>  <b>Object Oriented Programming Concepts</b>  Encapsulation, Abstraction, Inheritance, Polymorphism</p> <p><b>Fundamental Programming Structure</b>  Data Types, variable, keywords, typecasting, Arrays, Operators and their precedence.</p> <p><b>Control Flow</b>  Java's Control Statements (if, switch, iteration, statement, while, do-while, for, Nested loop).  Concept of Objects and Classes, Using Existing Classes building your own classes, constructor overloading, static , final, this keyword.</p>	CO1
UNIT2	<p><b>Inheritance:</b> Introduction, types of inheritance. Use of super keyword. Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.</p> <p><b>Packages &amp; Interfaces:</b> Packages, Access Protection, importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.</p> <p><b>Exception Handling:</b> Fundamentals, Types Checked , Unchecked exceptions, Using try &amp; catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception.</p>	CO2
UNIT3	<p><b>Multi-Threading</b>  Java Thread Life Cycle, Thread Priorities, Synchronization, creating a thread, Runnable interface, Creating Multiple threads, using isAlive () and join (), wait () &amp; notify ().</p> <p><b>String Handling</b>  String constructors, String length, Character Extraction, String Comparison, Modifying a string.</p> <p><b>Java I/O</b>  Classes &amp; Interfaces, Stream classes, Byte streams, Character streams, Serialization.</p>	CO3

<b>UNIT4</b>	<b>Wrapper Classes</b> Wrapper classes and its methods. <b>Collection Framework</b> Introduction, interfaces, List, Set, Map etc, List interfaces and its classes. <b>Introduction to Database</b> Introduction to Data Base. Driver Types, Registering Driver, Creating Connection, Executing SQL query using Statement, Prepared Statment. Result Set methods.	CO4
<b>UNIT5</b>	<b>Event Handling</b> Event Delegation Model, Event Classes, Event Listener Interfaces, Adapter classes. <b>AWT</b> AWT Classes window fundamentals, component, container, panel, Window, Frame , working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components <b>Swing</b> Icons & Labels, Text fields, Buttons, Combo boxes, Tabbed panes, Scroll panes, Trees, Tables.	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Seth, A., & Juneja, B.L. (Year). Java: One Step Ahead. Oxford University Press
2. . Sierra, K., & Bates, B. (Year). Head First Java (2nd ed.).
3. Schildt, H. (Year). JAVA Complete Reference (9th ed.).

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	1							2		
CO2	1	1	1					1		2	
CO3	1	1	2							2	
CO4	1					1					1
CO5				1							

## Indian Knowledge System (IKS)

<b>Course Name</b>	<b>Indian Knowledge System</b>
<b>Course Code</b>	<b>1003</b>
<b>Course Credit</b>	<b>3</b>
<b>Semester</b>	<b>II</b>
<b>Aims &amp; Objectives</b>	This course aims to provide a general introduction to Indian Knowledge System (IKS) and sensitize the students to the contributions made by ancient Indians in the field of Science, Philosophy and related applications and concepts.
<b>Course Outcomes</b>	At the end of this course the learner will be able to: <b>CO-1:</b> Understand the captivating voyage of the Indian Knowledge System. <b>CO-2:</b> Identify the different knowledge frameworks and linguistic patterns in India <b>CO-3:</b> Illustrate the usage of Vedic number system and units of measurement in real life scenario <b>CO-4:</b> Comprehend the vibrant tapestry of the town planning and architecture in ancient India <b>CO-5:</b> Map the past history with the current phenomenon in Indian geopolitical scenario
<b>Course Outline</b>	<b>Unit-1:</b> Indian Knowledge System – An Introduction. The Vedic Corpus, Philosophical Systems  <b>Unit-2:</b> Knowledge Framework and classifications, Linguistics  <b>Unit-3:</b> Number Systems and Units of Measurement  <b>Unit-4:</b> Town Planning and Architecture  <b>Unit-5:</b> Governance and Public Administration
<b>Evaluation</b>	Continuous Internal Evaluation (CIE): <b>40 marks</b> End Term Assessment: <b>60 marks</b>
<b>References</b>	<b>Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N.</b> (2022), “Introduction to Indian Knowledge System: Concepts and Applications”, PHI Learning Private Ltd. Delhi. <b>Additional Readings:</b> Jaishankar S(2020): The India Way: Strategies for an uncertain world, Harper Collins Jaishankar S(2023): Why Bharat matters, Rupa Publications India Pride of India: A Glimpse into India’s Scientific Heritage, Samskrita Bharati,

New Delhi.  
 Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.  
 Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.  
 Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.  
 Dasgupta,S. (1975). A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi.  
 PLofer, K. (1963). Mathematics in India, Princeton University Press, New Jersey, USA"

### Facilitating the Achievement of Course Outcomes

Sl. No	CO	Classroom Activities & Techniques	Assessment Method	Bloom's Taxonomy Level
CO1	Understand the captivating voyage of the Indian Knowledge System	Case Study Approach	Mock Test and MCQ	1,2
CO 2	Knowledge Framework and classifications, Linguistics	Vedic Wisdom	Role Play	2, 3
CO 3	Illustrate the usage of Vedic number system and units of measurement in real life scenario	Vedic Literature Readings	Essay Writing	1,3,4
CO 4	Comprehend the vibrant tapestry of the town planning and architecture in ancient India	Project Assignment	Site Visits	3, 4
CO 5	Map the past history with the current phenomenon in Indian geopolitical scenario	Project Assignment	Site Visits	3,4

**Bloom's Taxonomy:** Level 1: Remembering; Level 2: Understanding; Level 3: Applying; Level 4: Analysing; Level 5: Evaluating; Level 6: Creating

### Mapping of the Course Outcomes to the Program Outcomes (POs)

Course Outcomes (CO)	Program Outcomes (POs)									
	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PSO 1	PSO 2	PSO3
CO 1	1		3		3			2		2
CO 2		2	3	3			3	1	1	2
CO 3			3		2				1	2
CO 4		2	3			3		1		2
CO 5	2		3	2			3		1	1

## French Language – I

SYLLABUS		
<b>Semester</b>	I	
<b>Course Title</b>	French Language – I	
<b>Course Code</b>		
<b>Credits</b>	3	
<b>Contact Hours (L-T-P)</b>	3-0-0	
<b>Course Type</b>	AEC	
<b>Course Objectives</b>	<ul style="list-style-type: none"> <li>• Introduce students to the basics of the French language (A1 level).</li> <li>• Develop oral and written comprehension skills for simple interactions.</li> <li>• Introduce fundamental grammar and essential vocabulary.</li> <li>• Familiarize students with cultural aspects of the Francophone world.</li> </ul>	
<b>Course Outcomes (COs)</b>	<p>After completing this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• <b>CO1:</b> Sound and pronunciation of French words; Use simple expressions for greetings, self-introduction, and asking basic questions.</li> <li>• <b>CO2:</b> Employ vocabulary related to family, professions, city, housing, and leisure.</li> <li>• <b>CO3:</b> Read and understand short texts (announcements, dialogues).</li> <li>• <b>CO4:</b> Write simple sentences (personal introduction, email, postcard).</li> <li>• <b>CO5:</b> Identify elements of Francophone culture and compare them with their own.</li> </ul>	
COURSE OUTLINE		
Module	Contents	CO Mapping
I	<p>We discover French:</p> <ul style="list-style-type: none"> <li>• <b>Objectives:</b> <ul style="list-style-type: none"> <li>○ Discover the French language; Spell words using the French alphabet; Learn basic numbers</li> </ul> </li> <li>• <b>Grammar:</b> <ul style="list-style-type: none"> <li>○ Subject pronouns (<i>je, tu, il/elle</i>); Verbs: <i>être, s'appeler</i>; Definite articles; Gender of country names</li> </ul> </li> <li>• <b>Vocabulary:</b> Introduction and first names; Numbers; Country names; Days; Months and Seasons</li> <li>• <b>Activities:</b> Short dialogues, role-play for greetings, spelling practice games, interactive oral drills.</li> </ul>	CO1

II	<p>We learn French for...</p> <ul style="list-style-type: none"> <li>• <b>Objectives:</b> <ul style="list-style-type: none"> <li>○ Greetings; Introduce yourself and say goodbye; Ask for and give information; Give personal information; Introduce and identify a person; Ask question about identity and speak about your French class; Inform about a leaning object.</li> </ul> </li> <li>• <b>Grammar:</b> <ul style="list-style-type: none"> <li>○ <i>Tu</i> or <i>Vous</i>; Indefinite articles ; Interrogative words ; Personal Subject pronouns ; Verbs <i>Parler</i> and <i>s'appeler</i> in present tense ; <i>C'est</i> or <i>Il est/Elle est</i> ; Interrogative adjectives <i>quel(s), quelle(s)</i> ; Verb <i>avoir</i> in present tense and Possessive adjectives ; <i>Parce que</i> and <i>pour</i></li> </ul> </li> <li>• <b>Vocabulary:</b> Politeness; Nationalities; Professions; Introductions; Identities</li> <li>• <b>Activities:</b> Create an identity card, write a self-introduction, listen to short interviews, classroom survey on hobbies.</li> </ul>	CO2
III	<p>Get to know each other:</p> <ul style="list-style-type: none"> <li>• <b>Objectives:</b> <ul style="list-style-type: none"> <li>○ Name the countries and cities; Name and locate places in a city; Locate a palce and indicate a mode of transportation; Make acquaintances; Talk about a type of accommodation; Exchange information about an accommodation.</li> </ul> </li> <li>• <b>Grammar:</b> <ul style="list-style-type: none"> <li>○ Prepositions (Countries and cities name); Defnite and Indefinite articles; Preposition of place and Contracted articles; Verbs <i>Aller, Habiter, Venir</i> and <i>Prendre</i> in present tense; Demonstrative adjectives.</li> </ul> </li> <li>• <b>Vocabulary:</b> Names of countries and cities, Places in a city, Cardinal points and modes of transportation; Accomodation.</li> <li>• <b>Activities:</b> Role-play ordering at a café, reading a map, writing a postcard from a trip.</li> </ul>	CO3
IV	<p>We speak the same language</p> <ul style="list-style-type: none"> <li>• <b>Objectives:</b> <ul style="list-style-type: none"> <li>○ Speak about your family; Describe and characterize a person/people; Express preferences; Talk about yourself, your profession, your passion and your dream; Descrie your activities; Explain a health problem.</li> </ul> </li> <li>• <b>Grammar:</b> <ul style="list-style-type: none"> <li>○ Singular and plural possessive adjectives; The masculine, the feminine and the plural of descriptive adjective; Present tense of <i>er</i> ending verbs.</li> </ul> </li> <li>• <b>Vocabulary:</b> Family, Professions, Sports and artistic activities; Body parts.</li> </ul>	CO4

	<ul style="list-style-type: none"> <li>• <b>Activities:</b> Describe a photo of a living room, write a short email about your home, role-play finding an apartment.</li> </ul>	
V	<p>We speak about our daily routine:</p> <ul style="list-style-type: none"> <li>• <b>Objectives:</b> <ul style="list-style-type: none"> <li>○ Tell the time and schedule; Speak about your hobbies and daily routine; Talk about your workday; Speak about your outings; Propose an outing, invite, accept or refuse an invitation.</li> </ul> </li> <li>• <b>Grammar:</b> <ul style="list-style-type: none"> <li>○ Different ways to tell time; Pronominal verbs; Verbs <i>Pouvoir, Devoir, Vouloir, Sortir, Partir, lire and écrire</i> in present tense; Pronoun <i>on</i>; Ask questions; Imperative</li> </ul> </li> <li>• <b>Vocabulary:</b> Time and schedule; Daily routine and Habits; Outings</li> <li>• <b>Activities:</b> Plan a weekend activity, write a short message to invite someone, practice dialogues for accepting/refusing invitations.</li> </ul>	CO5

#### EVALUATION

	Theory	
<b>Mode of Evaluation</b>	<b>Continuous Evaluation</b>	<b>End Semester Examination</b>
Weightage	40	60

#### TEXT BOOKS AND REFERENCES

**Textbooks:**

Nathalie, Hirschsprung, and Tony, Tricot, *Cosmopolite 1: Méthode de français (A1)*. Hachette, 2018.

**References:**

Nathalie, Hirschsprung, and Tony, Tricot, *Cosmopolite 1: Cahier d'activités (A1)*. Hachette, 2018.  
 Dondo, Mathurin Marius, *Modern French Course*, Oxford University Press, 1997.

#### FACILITATING THE ACHIEVEMENT OF COS

Module No.	COs	Teaching & Learning Activity	Assessment Tools	Bloom's Taxonomy Level
I	CO1	Lecture and presentation	Assignment and test on French Reading, Listening, Writing, Speaking	
II	CO2	Lecture and presentation	Assignment and test on French Reading, Listening, Writing, Speaking	

III	CO3	Lecture and presentation	Assignment and test on French Reading, Listening, Writing, Speaking
IV	CO4	Lecture and presentation	Assignment and test on French Reading, Listening, Writing, Speaking
V	CO5	Lecture and presentation	Assignment and test on French Reading, Listening, Writing, Speaking

Bloom's Taxonomy:  
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

#### CO, PO & PSO MAPPING

Course Code and Course Name		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
French Language – I	CO1	2	3	2	1	2	3	2	1	3	2	1
	CO2	2	2	2	2	1	2	2	1	2	3	2
	CO3	1	2	2	1	-	3	2	1	-	2	1
	CO4	2	-	1	2	1	-	2	1	-	3	2
	CO5	1	2	3	1	2	3	1	2	3	1	2
	Avg.	1.6	1.8	2	1.4	1.2	2.2	1.8	1.2	1.6	2.2	1.6

Correlation level 1, 2 and 3 as defined below:

“1” – Slight (Low); “2” – Moderate (Medium); “3” – Substantial (High); “-” – No correlation

Continuous Internal Evaluation (CIE) - 40 Marks

Bloom's Category	Evaluation 1 (10)	Evaluation 2 (10)	Evaluation 3 (10)	Evaluation 4 (10)
Remember (Reading comprehension)	2.5	2.5	2.5	2.5
Understand (Listening comprehension)	2.5	2.5	2.5	2.5
Apply (Writing skills)	2.5	2.5	2.5	2.5
Analyze (Speaking skills)	2.5	2.5	2.5	2.5
Evaluate				
Create				

End Semester Examination (ESE) - 60 Marks

Bloom's Taxonomy Level	Marks Allocated
Understand (Reading comprehension)	15
Apply (Listening comprehension)	15
Analyze (Writing skills)	15
Evaluate (Speaking skills)	15
Create	-

### BCA -2011 Data Structure using C Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	II
<b>Course Title</b>	Data Structure using C Lab
<b>Course Code</b>	BCAL-2001
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	CC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To develop skills to design and analyze simple linear and nonlinear data structures.</li> <li>2. To strengthen the ability to the students to identify and apply the suitable data structure for the given real world problem.</li> <li>3. To enables them to gain knowledge in practical applications of data structures.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Student understands design and analyze the time and space efficiency of the data structure.</p> <p>CO2. Implement the Stack, Queue and their applications.</p> <p>CO3. Implement various types of linked lists and their applications</p> <p>CO4. Perform basic operations on BST</p> <p>CO5. Implement different sorting and searching algorithms.</p>

#### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
Lab 1	Implementations of pointers and arrays (As a prerequisite)	CO1
Lab 2	Implementation of Stack using Array	CO2
Lab 3	Implementation of Queue using Array	CO2
Lab 4	Creation of Linked list	CO3
Lab 5	Different operations on Linked list	CO3
Lab 6	Implementation of Stack using Linked list	CO2, CO3

Lab 7	Implementation of Queue using Linked list	CO3
Lab 8	Implementation and different operations on Doubly Linked list	CO3
Lab 9	Implementation and different operations on Circular Linked list	CO3
Lab 10	Implementation of Binary Search Tree and its Traversals	CO5
Lab 11	Implementation of Linear search, Binary search	CO5

### Evaluation:

Mode of Evaluation	Practical	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

### Text Books:

1. Gilberg, R., & Forouzan, B. (2016). Data Structures: A Pseudocode Approach with C (2nd ed.). Cengage.
2. Kruse, R.L., & Leung, C. T. (2008). Data Structures and Program Design in C (2nd ed.). Pearson.

### Reference Books:

1. Langsam, Y., Augenstein, M. J., & Tanenbaum, A. M. (2009). Data Structures Using C (3rd ed.). Pearson.
2. Mehlhorn, K., & Sanders, P. (2010). Algorithms and Data Structures: The Basic Toolbox. Springer.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	1	1							1		
CO2				1						1	
CO3	1								1		
CO4				1						1	
CO5		1								1	

## Object Oriented Programming using Java Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	II
<b>Course Title</b>	Object Oriented Programming using Java lab
<b>Course Code</b>	BCAL-2005
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	SEC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To teach the students basics of JAVA programs and its execution.</li> <li>2. To teach the students the differences between C++ and Java programming.</li> <li>3. To make the students learn concepts like packages and interfaces.</li> <li>4. To make the students understand life cycle of the applets and its functionality.</li> <li>5. To make the students understand the usage util package.</li> <li>6. To teach the student, to develop java programs using interfaces.</li> </ol>
<b>Course Outcome (COs)</b>	<p>CO1. Able to use Java compiler and eclipse platform to write and execute java program.</p> <p>CO2. Understand and Apply Object oriented features and Java concepts.</p> <p>CO3. Able to apply the concept of multithreading and implement exception handling.</p> <p>CO4. Able to access data from a Database with java program.</p> <p>CO5. understand the usage package.</p>

### Course Outline

<b>Lab</b>	<b>Description</b>	<b>CO Mapping</b>
<b>Lab :1</b>	<ul style="list-style-type: none"> <li>• Write a java program to print a string.</li> <li>• Write a java program to multiply two given matrices.</li> </ul>	<b>CO1</b>
<b>Lab :2</b>	<ul style="list-style-type: none"> <li>• Write a java program to display the employee details using Scanner class.</li> <li>• Write a java program that checks whether a given string is palindrome or not.</li> </ul>	<b>CO2</b>
<b>Lab :3</b>	<ul style="list-style-type: none"> <li>• Write a java program for Method overloading and Constructor overloading.</li> </ul>	<b>CO3</b>
<b>Lab :4</b>	<ul style="list-style-type: none"> <li>• Write a java program to represent Abstract class with example.</li> </ul>	<b>CO3</b>

	<ul style="list-style-type: none"> <li>Write a java program to implement Interface using extends keyword</li> </ul>	
<b>Lab :5</b>	<ul style="list-style-type: none"> <li>Write a java program to create user defined package.</li> </ul>	<b>CO1</b>
<b>Lab :6</b>	<ul style="list-style-type: none"> <li>Write a java program to create inner classes.</li> <li>Write a java program for creating multiple catch blocks.</li> </ul>	<b>CO1</b>
<b>Lab :7</b>	<ul style="list-style-type: none"> <li>Write a java program for producer and consumer problem using Threads.</li> </ul>	<b>CO2</b>
<b>Lab :8</b>	<ul style="list-style-type: none"> <li>Write a Java program that implements a multi-thread application that has three threads.</li> </ul>	<b>CO2</b>
<b>Lab :9</b>	<ul style="list-style-type: none"> <li>Write a java program to represent Array List class</li> </ul>	<b>CO3</b>
<b>Lab :10</b>	<ul style="list-style-type: none"> <li>Write a java program for handling Mouse events and Key events.</li> </ul>	<b>CO4</b>
<b>Lab :11</b>	<ul style="list-style-type: none"> <li>Write a java program that connects to a database using JDBC</li> </ul>	<b>CO4</b>
<b>Lab :12</b>	<ul style="list-style-type: none"> <li>Write a java program to connect to database using</li> </ul>	<b>CO5</b>

### Evaluation:

Mode of Evaluation	Laboratory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

### Text Books:

1. Seth, A., & Juneja, B.L. (Year). Java: One Step Ahead. Oxford University Press
2. . Sierra, K., & Bates, B. (Year). Head First Java (2nd ed.).
3. Schildt, H. (Year). JAVA Complete Reference (9th ed.).

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	1		1						2		
CO2	1	1									
CO3	1									2	
CO4								1			
CO5			1	1							1

## Second Year

### Semester –III

#### Python Programming

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	III
<b>Course Title</b>	<b>Python Programming</b>
<b>Course Code</b>	BCAT-3001
<b>Credit</b>	L-T-P- 3-0-0 Total Credit – 3
<b>Course Type</b>	
<b>Course Objective</b>	The course will enable students to: 1. Learn the syntax and semantics of Python Programming Language 2. Write Python functions to facilitate code reuse and manipulate strings. 3. Illustrate the process of structuring the data using lists, tuples and dictionaries. 4. Demonstrate the use of built-in functions to navigate the file system. 5. Appraise the need for working on web scraping
<b>Course Outcome (COs)</b>	Upon successful completion of this course, student will be able to CO1: Demonstrate the concepts of control structures in Python. CO2: Implement Python programs using functions and strings. CO3: Implement methods to create and manipulate lists, tuples and dictionaries. CO4: Apply the concepts of file handling and regEx using packages. CO5: Illustrate the working of scraping websites with CSV.

#### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT 1</b>	<b>Introduction</b> Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program. Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution,	CO1

	Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit().	
<b>UNIT 2</b>	<p><b>Functions</b></p> <p>Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling. Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods.</p> <p>Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things. Manipulating Strings - Working with Strings, Useful String Methods</p>	CO2
<b>UNIT 3</b>	<p><b>Pattern Matching with Regular Expressions</b></p> <p>Pattern Matching with Regular Expressions: Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Nongreedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re.IGNORECASE, re .DOTALL, and re .VERBOSE.</p>	CO3
<b>UNIT 4</b>	<p><b>Files</b></p> <p>Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint.pformat() Function. Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile</p>	CO4
<b>UNIT 5</b>	<p><b>Web Scraping</b></p> <p>Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML.</p> <p>Working with Excel Spreadsheets: Excel Documents, Installing the openpyxl Module, Reading Excel Documents, Project: Reading Data from a Spreadsheet, Writing Excel Documents, Project: Updating a Spreadsheet, Setting the Font Style of Cells, Font Objects, Formulas, Adjusting Rows and Columns,</p>	CO5

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

T1: Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990

### Reference Books:

R1: Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.

R2: Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.

R3: Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.

R4: Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.

R5: Reema Thareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	-	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	-	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2
CO4	3	2	3	2	3	-	-	-	-	-	-	1
CO5	3	3	2	2	3	1	-	-	-	-	-	2

### Database Management Systems

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	III
<b>Course Title</b>	Database Management Systems
<b>Course Code</b>	BCAT-3002

<b>Credit</b>	2
<b>Course Type</b>	cc
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. An understanding of basic concepts of DBMS.</li> <li>2. An introduction to the Entity Relationship Models.</li> <li>3. An understanding of Relational Algebra.</li> <li>4. An induction to constraints, View and SQL.</li> <li>5. An introduction to Transactions.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO1: Explain the needs of DBMS. CO2: Explain the working of ER models. CO3: Demonstrate the use of Relational Algebra. CO4: Explain the usage of constraints, View and SQL. CO5: Demonstrate the concepts of Transactions and ACID property.

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT 1</b>	<b>Introduction to Databases and Transactions and Data Models:</b> Database system, purpose of database system, view of data, relational databases, database architecture, Transaction management, The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction.	CO1
<b>UNIT 2</b>	<b>Database Design, ER-Diagram and Unified Modelling Language</b> Database design, ER Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, UML Relational database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).	CO2
<b>UNIT 3</b>	<b>Relational Algebra and Calculus</b> Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus (TRC), Domain relational Calculus (DRC), computational capabilities.	CO3
<b>UNIT 4</b>	<b>Constraints, Views and SQL</b> Types of constrains, Integrity constraints. Views: Introduction to views, data independence, security, updates on views, comparison between tables. Views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers. Database Language: SQL (DDL, DML, DCL), QBE.	CO4

<b>UNIT 5</b>	<b>Transaction management and Concurrency control</b> Transaction management: ACID properties, Transaction States, Types of Schedule, serializability, Precedence Graph, Recoverable Schedule, Cascade less Schedule. Concurrency control Protocol: Lock based concurrency control (2PL, Deadlocks), Timestamp based methods, Optimistic methods. Database recovery system.	CO5
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**Evaluation:**

<b>Mode of Evaluation</b>	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Book:**

1. “Database System Concepts”, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill

**References:**

- 1 “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer science Press.
- 2 “Fundamentals of Database Systems”, 5th Edition by R. Elmasri and S. Navathe, Pearson Education
- 3 “Foundations of Databases”, Reprint by Serge Abiteboul, Richard Hull, VictorVianu, Addison-Wesley

### Corporate Communication

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Corporate Communication
<b>Course Code</b>	BCAT-3003
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	IDC

<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. To gain a comprehensive understanding of the principles, theories, and models underlying corporate communication practices in various organizational contexts</li> <li>2. To enhance oral, written, and digital communication skills essential for conveying corporate messages effectively,</li> <li>3. To critically evaluate real-world corporate communication strategies and campaigns, examining their effectiveness, ethical implications, and impact on stakeholders</li> <li>4. To analyse and solve communication challenges faced by corporations</li> <li>5. To explore the ethical dimensions and cultural nuances of corporate communication</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <ol style="list-style-type: none"> <li>CO1. Demonstrate proficiency in crafting and delivering corporate messages across various communication channels, including written, verbal, and digital platforms.</li> <li>CO2. Analyze and evaluate the effectiveness of corporate communication strategies by applying theoretical frameworks and considering ethical and cultural factors.</li> <li>CO3. Develop comprehensive communication plans tailored to corporate objectives, incorporating audience analysis, message framing, and channel selection.</li> <li>CO4. Improve their interpersonal communication skills, including active listening, conflict resolution, and negotiation.</li> <li>CO5. Develop an awareness of ethical issues in corporate communication and cultivate professionalism in their interactions, demonstrating sensitivity to cultural diversity and ethical dilemmas.</li> </ol>

### Course Outline

Unit	Description	CO Mapping
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<p><b>UNIT1</b></p>	<p><b>Foundations of Corporate Communication</b>  <b>1.1: Introduction to Corporate Communication</b></p> <ul style="list-style-type: none"> <li>• Overview of corporate communication principles and theories: Organizational communication, Corporate Identity, and Reputation Management. Introduction to communication models like the Shannon-Weaver Model, Transactional Model, and Coordinated Management of Meaning (CMM) Historical evolution and current trends: Historical development of corporate communication from traditional forms to contemporary practices. Current trends such as Digital Transformation, Stakeholder Engagement, and Sustainability Communication.</li> <li>• Practical Activities: Communication plan for a fictional company, outlining objectives, target audience, messaging, and communication channels.</li> </ul> <p><b>1.2: Communication Skills Development</b></p> <ul style="list-style-type: none"> <li>• Writing effective corporate communications: crafting clear, concise, and professional written communication, including emails, memos, reports, and press releases. Oral communication skills development: Exercises to improve public speaking skills, Audience Analysis. Including structuring presentations, using visual aids effectively, and delivering persuasive speeches.</li> <li>• Role-playing scenarios to enhance verbal communication in meetings, negotiations, and networking events.</li> <li>• Practical Activities: Mock presentations where students deliver speeches on various topics related to corporate communication, followed by peer feedback and self-reflection.</li> </ul>	<p><b>CO1</b></p>
<p><b>UNIT2</b></p>	<p><b>Module 2: Analyzing Corporate Communication Strategies</b>  <b>2.1: Understanding Communication Strategies</b></p> <ul style="list-style-type: none"> <li>• Models and frameworks for analyzing communication strategies: Exploration of theoretical frameworks such as the RACE model (Research, Action, Communication, Evaluation) and PESO model (Paid, Earned, Shared, Owned). Application of strategic communication planning tools like SWOT analysis, stakeholder mapping, and message mapping.</li> <li>• Practical Activities: Analyze real-world corporate communication campaigns and create</li> <li>• SWOT analyses to identify strengths, weaknesses, opportunities, and threats.</li> </ul> <p><b>2.2: Case studies analysis</b></p> <ul style="list-style-type: none"> <li>• Analysis of real-world corporate communication campaigns, including successful and unsuccessful examples. Identification of key elements such as objectives, target audience, messaging, channels, and evaluation metrics.</li> </ul>	<p><b>CO2</b></p>

<b>UNIT3</b>	<p><b>Communication Ethics</b></p> <p><b>3.1: Ethical dimensions in corporate communication</b></p> <ul style="list-style-type: none"> <li>Ethical principles: honesty, transparency, integrity, and accountability, in corporate communication. Ethical theories: Consequentialism, Deontology, Social Contract Theory</li> </ul> <p><b>3.2: Ethical dilemmas</b></p> <ul style="list-style-type: none"> <li>Examination of ethical dilemmas faced by organizations through case studies</li> <li>Practical Activities: Role-playing scenarios where students act out ethical dilemmas faced by corporate communicators. Afterward, facilitate a discussion on the decisions made and the ethical considerations involved.</li> </ul>	<b>CO3</b>
<b>UNIT4</b>	<p><b>Digital Communication and Interpersonal Skills</b></p> <p><b>4.1: Digital Communication Strategies</b></p> <ul style="list-style-type: none"> <li>Role of digital communication and social media: Exploration of the impact of digital technologies and social media platforms on corporate communication practices.</li> <li>Developing social media strategies: Best practices for leveraging digital channels for brand building, and customer engagement, Planning and executing social media campaigns to achieve communication objectives, including content creation, community management, and performance measurement to LinkedIn.</li> <li>Practical Activities: Go Live in a group discussing meaningful information.</li> </ul> <p><b>4.2: Interpersonal Communication Skills</b></p> <ul style="list-style-type: none"> <li>Enhancing interpersonal communication skills: active listening, empathy, and nonverbal communication to improve interpersonal interactions in professional settings.</li> <li>Conflict resolution techniques: Strategies for identifying sources of conflict, facilitating constructive dialogue, and negotiating mutually acceptable solutions.</li> </ul>	<b>CO4</b>
<b>UNIT5</b>	<p><b>Global Communication and Cultural Competence</b></p> <p><b>5.1: Cultural Dimensions in Communication</b></p> <ul style="list-style-type: none"> <li>Understanding cultural nuances in communication: Cultural Dimensions, Cross-cultural communication etiquette, Cultural barriers and how to overcome them.</li> <li>Practical Activities: Cultural immersion experience where students explore different cultural practices, communication styles, and etiquette through interactive workshops or field trips.</li> </ul>	<b>CO5</b>

**Evaluation:**

<b>Mode of Evaluation</b>	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Excellence in Public Relations and Communication Management&quot; by James E. Grunig,  
Larissa A. Grunig, David M. Dozier, and Fred C. Repper. Routledge Abingdon, UK. 2013
2. Business Ethics: Ethical Decision Making & Cases&quot; by O.C. Ferrell, John Fraedrich, and Linda Ferrell Cengage Learning Boston, MA, USA. 2018

**Reference Books:**

1. Strategic Planning for Public Relations&quot; by Ronald D. Smith. Routledge Abingdon, UK. 2019
2. Digital Marketing: Strategy, Implementation and Practice&quot; by Dave Chaffey and Fiona Ellis-Chadwick. Pearson Harlow, UK. 2019
3. The Culture Map: Breaking Through the Invisible Boundaries of Global Business&quot; by Erin Meyer. Public Affairs New York, NY, USA. 2014

**Financial Institution & Market**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Financial Institution & Market
<b>Course Code</b>	BCAT-3004
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	MDC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. To provide the student a basic knowledge of financial markets and institutions and to familiarize them with Major financial services in India.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <ol style="list-style-type: none"> <li>CO1. Students are able to know the features of different financial markets and their role in economic development.</li> <li>CO2. Students are able to know the functions of financial markets and capital markets.</li> <li>CO3. Students are able to know about the commercial Banks and their role in project financing and working</li> </ol>

	<p>capital finance and also about the massive growth of NPAs.</p> <p>CO4. Students are able to know about the role of insurance companies, NBFCs and Mutual Funds.</p> <p>CO5. Understand the basics of financial services and its various dimensions.</p>
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### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	<p><b>An Introduction to Financial System and its Components:</b></p> <p>Financial markets and institutions. Financial intermediation, Functions and components of Financial System Financial system and economic development. An overview of the Indian financial system.</p>	CO1
<b>UNIT2</b>	<p><b>Financial Markets &amp; Capital Markets:</b></p> <p>Money market-functions, organization and instruments. Role of Central Bank in the money market; Indian money market-An overview.Capital Markets-functions, organization and instruments. Indian debt market; Indian equity market-primary and secondary markets; Role of stock exchanges in India.</p>	CO2
<b>UNIT3</b>	<p><b>Financial Institutions-I:</b></p> <p>Commercial banking-introduction, its role in project finance and working capital finance. Development Financial Institutions (DFIs),problems of NPA, Financial Inclusion.</p>	CO3
<b>UNIT4</b>	<p><b>Financial Institutions-II:</b></p> <p>Life and non-life insurance companies in India; Non-banking financial companies (NBFCs); Mutual Funds; Types and role in Capital Market, Regulation of Mutual Funds.</p>	CO4
<b>UNIT5</b>	<p><b>Financial Services:</b></p> <p>Leasing and hire-purchase, Consumer and housing finance; Venture capital finance; Factoring services, Bank Guarantees and Bank Undertakings, Letter of Credit; Credit Rating Agencies.</p>	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Pathak B. V. Indian Financial System, Pearson
2. Bhole, L.M., Financial Markets and Institutions. Tata McGraw Hill Publishing Company

**Reference Books:**

1. Khan, M.Y., Indian Financial System-Theory and Practice. New Delhi: Vikas Publishing House
2. Annual Reports of Major Financial Institutions in India.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2	1	1						2		
CO2		1		2							2
CO3						1	1	1		1	
CO4		2		1							1
CO5								1			

**Artificial Intelligence**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	III
<b>Course Title</b>	Artificial Intelligent
<b>Course Code</b>	BCAT-3005
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	IDC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Develop a comprehensive understanding of the fundamental concepts and applications of Artificial Intelligence.</li> <li>2. Gain knowledge of the major techniques and technologies used in Machine Learning and their applications in various domains.</li> <li>3. Develop an understanding of Natural Language Processing and its applications in fields such as chatbots, sentiment analysis, and language translation.</li> <li>4. Explore the applications and techniques of Computer Vision in real-world scenarios and understand the ethical considerations related to its use.</li> </ol>

	5. Stay up-to-date with emerging trends and advancements in AI, and understand their implications for society and the workforce.
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Students will be able to define Artificial Intelligence, describe its history and applications, and analyze ethical considerations related to AI.</p> <p>CO2. Students will be able to understand the basics of Machine Learning, including the different types of algorithms, data preparation, and processing. They will also be able to identify successful Machine Learning projects.</p> <p>CO3. Students will be able to identify the different techniques used in Natural Language Processing, understand the applications of NLP, and identify the ethical considerations related to NLP.</p> <p>CO4. Students will be able to identify the different techniques used in Computer Vision, understand the applications of Computer Vision, and identify the ethical considerations related to Computer Vision.</p> <p>CO5. Students will be able to identify emerging trends in Artificial Intelligence, including advanced AI technologies and techniques, AI and IoT, AI and Robotics, and future directions of AI research and development. They will also be able to analyze the implications of AI for society and the workforce.</p>

### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	<b>Introduction to Artificial Intelligence:</b> Definition of Artificial Intelligence, Brief history of Artificial Intelligence, Applications of Artificial Intelligence, Ethical considerations in Artificial Intelligence, Overview of AI technologies and techniques	CO1
<b>UNIT2</b>	<b>Machine Learning:</b> Introduction to Machine Learning, Types of Machine Learning algorithms, Supervised, unsupervised and reinforcement learning, Data preparation and processing for Machine Learning, Case studies of successful Machine Learning projects	CO2
<b>UNIT3</b>	<b>Natural Language Processing (NLP):</b> Introduction to NLP, Basic techniques of NLP, Applications of NLP, NLP libraries and tools, Ethical considerations in NLP	CO3
<b>UNIT4</b>	<b>Computer Vision:</b> Introduction to Computer Vision, Basic techniques of Computer Vision, Applications of Computer Vision, Computer Vision libraries and tools, Ethical considerations in Computer Vision	CO4
<b>UNIT5</b>	<b>Emerging Trends in Artificial Intelligence:</b> Advanced AI technologies and techniques, AI and Internet of Things (IoT), AI and Robotics, Future directions of AI research and development, Implications of AI for society and the workforce	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Russell, S. J., & Norvig, P. (2020). Artificial intelligence: A modern approach. Pearson.

**Reference Books:**

1. Bishop, C. M. (2006). Pattern recognition and machine learning. Springer.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT press.
3. Shane, M. (2018). Artificial intelligence and ethics. Morgan & Claypool Publishers.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2	1	1						2		
CO2		1		2							2
CO3						1	1	1		1	
CO4		2		1							1
CO5								1			

**Computer Network**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Computer Networks
<b>Course Code</b>	BCAT-3006
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC

<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. An understanding of basic concepts of computer networks.</li> <li>2. An introduction to Data Link Layer.</li> <li>3. An understanding of Network Layer.</li> <li>4. An introduction to Transport Layer.</li> <li>5. An introduction to Presentation and Application Layer.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <p>CO1. Explain the needs of Computer Networks.</p> <p>CO2. Explain the working and need of Data Link Layer.</p> <p>CO3. Demonstrate the use of and working of Network Layer.</p> <p>CO4. Explain the working of Transport Layer.</p> <p>CO5. Explain the need and working of Presentation and Application Layer.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction:</b> Goal and application Network Hardware and Software , Protocol hierarchies, Design Issue of the layers, Interfaces and services, Connection oriented and connection less services, Service Primitives, Reference Models – The OSI Reference model, The TCP/IP Reference Model, Types of computer Network :LAN,MAN,WAN, Topologies, Transmission mode .Physical Layer: Transmission Media, Concept of data transmission, Switching Techniques.	CO1
<b>UNIT2</b>	<b>Data Link Layer:</b> Data Link Layer design issues, Framing, Flow control, Error Detection and Correction DLL Protocol: Stop and Wait Protocol, Sliding window protocol, A Simplex protocol for noisy channel, medium access sublayer: Channel allocation – static and dynamic, Multiple access protocol FDDI, Data Link Layer in the Internet – SLIP, PPP.	CO2
<b>UNIT3</b>	<b>Network Layer:</b> The Network Layer Design Issue, comparison of virtual circuits and datagram subnets, connectionless internetworking, Tunnelling, Internetwork routing, Routing algorithm, Fragmentation, The Network Layer in the Internet – The IP Protocol, IP Address, subnets, Internet control protocols, internet multicasting.	CO3
<b>UNIT4</b>	<b>Transport Layer:</b> The Transport layer services, the concept of client and server in terms of socket addressing Quality, of service, Transport service primitives and buffering, Multiplexing, Crash Recovery. The Internet Transport Protocols (TCP/IP) – The TCP Service Model, The TCP protocol, The TCP segment header, TCP connection management, TCP transmission policy, TCP congestion control, TCP timer management, UDP.	CO4

<b>UNIT5</b>	<b>Presentation and Application Layer:</b> Network Security – Traditional Cryptography, Two fundamental Cryptographic Principles, Secret Key Algorithms Public key Algorithms, Authentication protocols, DNS, E-mail.	CO5
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**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Forouzan, B. A. (2007). Data Communications and Networking (2nd ed.). TMH.
2. Tanenbaum, A. S. (2013). Computer Networks. Pearson Education.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	1								1		
CO2		1	1							1	
CO3		1	1						1		
CO4				1						1	
CO5	1			1					1		

**Python Programming Lab**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-2029
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	III
<b>Course Title</b>	<b>Python Programming Lab</b>
<b>Course Code</b>	BCAL-3001
<b>Credit</b>	L-T-P- 0-0-2 Total Credit – 1
<b>Course Type</b>	
<b>Course Objective</b>	This course enables the students <ol style="list-style-type: none"> <li>1. To be able to introduce core programming basics and program design with functions using Python programming language.</li> <li>2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.</li> </ol>

	3. To understand the high-performance programs designed to strengthen the practical expertise.
<b>Course Outcome (COs)</b>	Upon the completion, the student will be able to: CO1: Student should be able to understand the basic concepts scripting and the contributions of scripting language CO2: Ability to explore python especially the object oriented concepts, and the built in objects of Python.

### Course Outline

Unit	Description
<b>Lab 1</b>	Programs on Introduction to Python and Computer Programming
<b>Lab 2</b>	Data Types, Variables, Basic Input-Output Operations, Basic Operators
<b>Lab 3</b>	Boolean Values, Conditional Execution, Loops.
<b>Lab 4</b>	Lists and List Processing, Logical and Bitwise Operations
<b>Lab 5</b>	Functions, Tuples
<b>Lab 6</b>	Dictionaries, and Data Processing
<b>Lab 7</b>	Modules, Packages, String and List Methods, and Exceptions
<b>Lab 8</b>	The Object-Oriented Approach: Classes, Methods, Objects, and the Standard Objective Features;
<b>Lab 9</b>	Exception Handling, and Working with Files
<b>Lab 10</b>	Programs on web scraping
<b>Lab 11</b>	Programs on sheet update

### Text Books:

T1: Al Sweigart, "Automate the Boring Stuff with Python", William Pollock, 2015, ISBN: 978-1593275990

### Reference Books:

R1: Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.

R2: Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.

R3: Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.

R4: Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, "Data Structures and Algorithms in Python", 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.

R5: Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978-0199480173

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	-	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	-	-	2
CO3	3	2	1	-	2	-	-	-	-	-	-	1
CO4	3	3	3	2	1	-	-	-	-	-	-	2
CO5	1	2	3	1	0	-	-	-	-	-	-	1

### Database Management Systems Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Database Systems Lab
<b>Course Code</b>	BCAL-3002
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	SEC
<b>Course Objective</b>	The subject aims to provide the student with: 1. An understanding of basic concepts of DBMS. 2. An introduction to the Entity Relationship Models. 3. An understanding of Relational Algebra. 4. An induction to constraints, View and SQL. 5. An introduction to Transactions.
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO1. Acquire a good understanding of database systems concepts. CO2. Create and maintain tables using PL/SQL. CO3. Application development using PL/SQL & front end tools CO4. Understand the use of structured query language and its syntax. CO5. Demonstrate an understanding of the relational data model.

## Course Outline

Unit	Description	CO Mapping
Lab 1-2	<ul style="list-style-type: none"> <li>• Introduction to basic DDL, DML and DCL commands and domain types in SQL.</li> <li>• DDL statements to create, drop, alter, view and rename the Database.</li> </ul>	<b>CO1, CO2, CO5</b>
Lab 3	<ul style="list-style-type: none"> <li>• Write DML statements to insert the values into the tables. Use variants to insert values such as insert multiple records and insert records resulting from a select query.</li> <li>• Write statements to add and delete a column in a table which is pre-existent.</li> <li>• Write DML statements to update a table for single and multiple field updation.</li> <li>• Write DML statements to delete single or multiple record(s) from a table.</li> </ul>	<b>CO1, CO2, CO5</b>
Lab 4-5	<ul style="list-style-type: none"> <li>• Practice SELECT query with following options: Distinct, order by, between, top/max/min and other aggregation keywords, group by, having, wild card matching, exists</li> <li>• Nested subqueries</li> </ul>	<b>CO3, CO4, CO5</b>
Lab 6	<ul style="list-style-type: none"> <li>• Practice SELECT query with following options: Distinct, order by, between, top/max/min and other aggregation keywords, group by, having, wild card matching, exists</li> <li>• Nested subqueries</li> </ul>	<b>CO4, CO5</b>
Lab 7	<ul style="list-style-type: none"> <li>• Write a query to create INNER JOIN / LEFT JOIN / RIGHT JOIN / FULL JOIN in two tables.</li> </ul>	<b>CO4, CO5</b>
Lab 8	<ul style="list-style-type: none"> <li>• Add primary key constraint to a pre-existent table.</li> <li>• Add NOT NULL / UNIQUE constraint to a pre-existent column.</li> <li>• Define the foreign key constraint. Show the errors returned by Database when: <ul style="list-style-type: none"> <li>• a) FK constraint is violated</li> <li>• b) A referenced item is deleted</li> </ul> </li> <li>• Define and demonstrate cascading effect in foreign key referenced tables.</li> <li>• Define, add and drop the check/default constraint.</li> <li>• Define auto increment arguments/attributes of a table.</li> </ul>	<b>CO2, CO4, CO5</b>
Lab 9	<ul style="list-style-type: none"> <li>• Write a query to create/delete VIEW from two tables including some selection criteria.</li> <li>• Write a query to create and delete clustered/non-clustered index for a table.</li> </ul>	<b>CO5</b>
Lab 10-11	<ul style="list-style-type: none"> <li>• To implement the concept of trigger in database: <ul style="list-style-type: none"> <li>▪ How to apply database triggers</li> <li>▪ Types of database triggers</li> <li>▪ Create/delete database triggers</li> </ul> </li> </ul>	<b>CO5</b>

	<ul style="list-style-type: none"> <li>▪ Create trigger to demonstrate magic tables (INSERTED and DELETED).</li> <li>▪ Create a hypothetical situation to undo the changes in a table via Trigger (Max credit limit reached/ Balance insufficient etc.).</li> </ul>	
Lab 12-13	<ul style="list-style-type: none"> <li>• Write some stored procedures to cover the following problems: <ul style="list-style-type: none"> <li>▪ Demonstrate Control structures</li> <li>▪ Swap two numbers</li> <li>▪ Find the sum of digits</li> <li>▪ Calculate grades etc.</li> </ul> </li> <li>• Define Transaction, demonstrate the Commit and Rollback operations using hypothetical situations.</li> </ul>	<b>CO4, CO5</b>

**Evaluation:**

Mode of Evaluation	Practical	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2								1		
CO2		\1								1	
CO3			1	1							
CO4	2								1		1
CO5		1	1								

## Semester -IV

### Data Mining

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Data Mining Using Python
<b>Course Code</b>	BCAT-4001
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	IDC
<b>Course Objective</b>	The subject aims to provide the student with: 6. An understanding of basic concepts of Data Mining 7. An understanding of different types of Data 8. An understanding of Pre-processing of Data 9. An understanding of mining frequent patterns and associations 10. An introduction to cluster analysis
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO6. Explain the needs of Data Mining CO7. Explain the requirement of Data Exploration and its uses. CO8. Explain the process of Data Pre-processing CO9. Explain the working of Association Rule Mining with its use cases. CO10. A better understanding of clustering data

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction Data Mining</b> Introduction, Data, Types of Data, Data Mining Functionalities, Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse Issues, Data Preprocessing	<b>CO1</b>
<b>UNIT2</b>	<b>Data Exploration</b> Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data visualization, Data Similarity and Dissimilarity	<b>CO2</b>

<b>UNIT3</b>	<b>Data Pre processing</b> <b>Data cleaning:</b> Noisy Data Removal, Duplicates Removal, Missing value handling, Outlier detection and removal <b>Data transformation:</b> Data type conversion (categorical data to numerical data), Data Reduction (PCA, LDA) <b>Data normalization:</b> min-max normalization and z-score normalization	<b>CO3</b>
<b>UNIT4</b>	<b>Mining Frequent Patterns, Associations, and Correlations</b> Mining Frequent Patterns, Associations and Correlations, Mining Methods, Mining various Kinds of Association Rules, Correlation Analysis, Constraint Based Association Mining Classification and Prediction.	<b>CO4</b>
<b>UNIT5</b>	<b>Cluster Analysis</b> Cluster Analysis, Types of Data, Categorization of Major Clustering Methods, K-means, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data, Constraint, Based Cluster Analysis.	<b>CO5</b>

**Evaluation:**

<b>Mode of Evaluation</b>	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Book:**

1. Han, J., Pei, J. and Tong, H., 2022. Data mining: concepts and techniques. Morgan kaufmann

<b>CO</b>	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								1		
CO2		1	1						1		
CO3	2			1						1	
CO4	2							1			1
CO5	2								1		

## Design Analysis and Algorithm

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Design and Analysis of Algorithms
<b>Course Code</b>	BCAT-4002
<b>Credit</b>	4
<b>Course Type</b>	CC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>3. To educate students regarding basic principles of algorithms.</li> <li>4. To sensitize students about the fundamental strategies behind algorithms.</li> <li>5. To equip students with skills of Graphs, Trees algorithms</li> <li>6. To train students on selected topics of algorithms.</li> <li>7. To inculcate the advanced data structures.</li> </ol>
<b>Course Outcome (COs)</b>	<p><b>After completion of this course students will be able to:</b></p> <p>CO1. Understanding the basic concepts of time and space complexity            CO2. Understand the basic concepts of algorithms.            CO3. Understand and apply of different algorithmic approaches            CO4. Analyse the skills of Graphs, Trees algorithms.            CO5. An understanding of selected topics like hard problems.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT 1</b>	<p><b>Introduction</b>            Fundamental characteristics of an algorithm. Algorithm analysis – Asymptotic analysis of complexity bounds – best, average and worst-case behaviour, standard notations for expressing algorithmic complexity. Empirical measurements of performance, time and space trade-offs in algorithms.</p>	CO1
<b>UNIT 2</b>	<p><b>Fundamental Algorithmic Strategies:</b>            Divide-and-conquer algorithm. Using recurrence relations to analyze recursive algorithms – illustrations using recursive algorithms. Heapsort, quicksort, merge sort.</p>	CO2
<b>UNIT 3</b>	<p>Brute-Force, Greedy, Branch-and-Bound, Backtracking and Dynamic Programming methodologies as techniques for design of algorithms – Illustrations of these techniques for Problem-Solving. Matrix chain</p>	CO3

	application, Subset-sum and Knapsack problems, Longest common subsequence, Optimal binary search trees. Heuristics – characteristics and their domains of applicability. Design of algorithms for String problems, Huffman Code and Data compression problems.	
<b>UNIT 4</b>	<b>Graph and Tree Algorithms:</b> Representation of graphs, Transitive closure, Minimum Spanning Tree, Topological sort, Network Flow problems. Single source shortest path - The Bellman-Ford algorithm, Multi-source shortest paths in directed acyclic graphs, Dijkstra’s algorithm. Red-black trees, B-Trees- definition, basic operation on B-trees, insertion and deletion in B-trees.	C04
<b>UNIT 5</b>	<b>Selected Topics:</b> NP-HARD AND NP-COMPLETE PROBLEMS: Basic concepts, non-deterministic algorithms, NP-hard and NP-complete classes, Cook’s theorem.	C05

### Evaluation:

<b>Mode of Evaluation</b>	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	30	70

### TEXT BOOK

1. Cormen et al., “Introduction to Computer Algorithms Algorithm”, Prentice Hall India.
2. Algorithm Design – Jon Kleinberg and Eva Tardos

### REFERENCE BOOKS

1. Fundamentals of Algorithms – E. Horowitz et al.
2. Combinatorial Optimization: Algorithms and Complexity – C.H. Papadimitriou et al.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2								1		
CO2		1	1						1		
CO3	2			1						1	
CO4	2							1			1
CO5	2								1		

## Operating Systems

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Operating System
<b>Course Code</b>	BCAT-4003
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To educate students regarding basics of operating system.</li> <li>2. To sensitize students about organization and process scheduling.</li> <li>3. To equip students with concurrency.</li> <li>4. To train students about memory management.</li> <li>5. To inculcate the benefits of File systems and storage management.</li> </ol>
<b>Course Outcome (COs)</b>	<p><b>After completion of this course students will be able to:</b></p> <p>CO1. Understand the basic concepts of operating system.            CO2. Apply the organization and process scheduling.            CO3. Analyse the process synchronization.            CO4. An understanding of memory management.            CO5. Develop understanding of File systems and storage management.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT 1</b>	<p><b>Introduction</b></p> <p>Functions, components and structure of OS. Types of Operating Systems– Multiprogramming, Batch and Time Shared; Operating Systems for Personal Computers, Workstations, Hand-held Devices, Real time Systems, Operating System services, System Calls.</p>	CO1
<b>UNIT 2</b>	<p><b>Organization and Process Scheduling</b></p> <p>Processor and User Modes, Kernels, Process and Resources, Context switching, Threads, Threading Issues, Thread Libraries; Process Scheduling, Non-Pre-emptive and Pre-emptive Scheduling Algorithms, Multiprocessor scheduling. Deadlocks - Resource allocation and management, conditions for deadlock, Deadlock handling mechanisms: prevention, avoidance, detection, recovery.</p>	CO2

<b>UNIT 3</b>	<b>Process Synchronization</b> Inter-process communication, Synchronization - Implementing synchronization primitives (Peterson's solution, Bakery algorithm, synchronization hardware), Semaphores, Classical synchronization problems, Monitors, Classical IPC Problems: Reader's & Writer Problem, Dining Philosopher Problem etc., Multiprocessors and Locking - Scalable Locks - Lock-free coordination.	CO3
<b>UNIT 4</b>	<b>Memory Management</b> Physical and Virtual Address Space; Main memory management, Memory Allocation Strategies, Virtual memory: Hardware support for virtual memory (caching, TLB), Paging, Segmentation, Demand Paging, Page Faults, Page Replacement, Thrashing - Working Set.	C04
<b>UNIT 5</b>	<b>File Systems, storage management and security</b> Concept of a file, Directory Structure, File Operations, File System Mounting, File Sharing, Protection, File System Structure, File System Implementation, I/O Systems- Overview of Mass Storage Structure, Device Drivers, Disk Structure, Disk Scheduling, Disk Management, and Swap space Management, Free-space Management, Directory Implementation, RAID Structure	CO5

#### Evaluation:

Mode of Evaluation	Theory	
	Continuous Evaluation	End Semester Examination
Weightage	40	60

#### Text Book

1. Silberschatz, A., Galvin, P.B., & Gagne, G. (2008). Operating Systems Concepts (8th ed.). John Wiley Publications.

#### Reference Books

1. Tanenbaum, A. S. (2016). Modern Operating Systems (4th ed.). Pearson.
2. Stallings, W. (2018). Operating Systems: Internals and Design Principles (9th ed.). Pearson.
3. Milenkovic, M. (1992). Operating Systems: Concepts and Design. Tata McGraw Hill.

	CORRELATION WITH PROGRAM OUTCOMES	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES
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CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2		1						1		
CO2	1	2									
CO3	1	2		1						1	
CO4	1										
CO5		1		1					1		

### Optimization Techniques

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Optimization Techniques
<b>Course Code</b>	BCAT-4004
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To make students understand the basics of optimization.</li> <li>2. An introduction to single variable optimization.</li> <li>3. An introduction to multivariable optimization.</li> <li>4. An induction to constrained optimization algorithm.</li> <li>5. An understanding of modern optimization algorithm.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Students understand the basic concept of optimizations problems and techniques</p> <p>CO2. Explore various single variable optimization.</p> <p>CO3. Sound knowledge of multivariable optimization.</p> <p>CO4. Skills to understand constrained optimization algorithms.</p> <p>CO5. Perform modern optimization algorithms.</p>

### Course Outline

Unit	Description	CO Mapping
UNIT1	<b>Introduction and Basic Concepts</b> Introduction to optimization problem, optimization problem formulation, examples of optimization problems, Local and global optimization, optimization algorithms	CO1

<b>UNIT2</b>	<b>Single Variable Optimization</b> Optimality criteria, exhaustive search methods, bounding phase method, region-elimination methods-Fibonacci search method, golden section search method. Successive quadratic estimation Method, Gradient based methods-Newton-Raphson method, Bisection method, Sacant method	CO2
<b>UNIT3</b>	<b>Multivariable Optimization</b> Optimality criteria, unidirectional search, direct search methods- evolutionary search method, simplex search method, Hook-Jeeves pattern search method, Gradient-based methods: Cauchy's steepest descent method, Newton's method, Marquardt's method,	CO3
<b>UNIT4</b>	<b>Constrained Optimization Algorithms</b> Kuhn-Tucker conditions, transformation methods, sensitivity, direct search for constrained optimization, integer programming, Geometric programming.	CO4
<b>UNIT5</b>	<b>Modern Optimization Techniques</b> Genetic algorithms, simulated annealing, swarm optimization, ant colony optimization	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books

1. Deb, K. (Year). Optimization for Engineering Design: Algorithms and Examples. PHI.
2. Rao, S. S. (2019). Engineering Optimization: Theory and Practice (5th ed.). Wiley.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	1			2						1	
CO2		1							1		
CO3	1										1
CO4			1						1		
CO5				2	1					1	

## Internet and Web Technology

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Internet and Web Technologies
<b>Course Code</b>	BCAT-4005
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	IDC
<b>Course Objective</b>	The subject aims to provide the student with: 1. An understanding of competency in planning a website. 2. An ability to incorporate social media aspects, web–design principles like text and navigation 3. An understanding of Hosting / launching a website
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO1. Understanding the web design concept, planning and development. CO2. Understand the website goals, business requirements and project plan CO3. Understand the platform selection and content management CO4. Understand the concept of web analytics CO5. Understanding the concept of visitor count, website visibility and best practices.

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction to Web Application:</b> An Introduction to Website Design Concept of web development, planning your website strategy, Design to sell, Online value Proposition, Writing an excellent copy, Dynamic design and personalization.	CO1
<b>UNIT2</b>	<b>Getting Started in Web Design:</b> Understanding site goals, Gathering business requirements, Developing an RFP, Building a project plan, Creating a sitemap, Developing wireframes, User testing, Putting together a content plan, Content development, Media development, Developing the backend, Quality assurance and maintenance, essentials for making the design more user friendly.	CO2
<b>UNIT3</b>	<b>Platform Selection, Content Management:</b> Introduction to HTML, DHTML, JavaScript, jQuery, and Ajax, Working with CSS, Introduction to Content	CO3

	management system, connecting a website to a CMS, Optimising your website, extending website functionality, fundamentals e-commerce websites.	
<b>UNIT4</b>	<b>Web Analytics:</b> Getting started with web analytics and handling web data, selecting the right web analytics tools, Reviewing Site Referrers.	CO4
<b>UNIT5</b>	Getting to Know Your Visitors, Identifying Your Most Important Pages, Key Performance Indicators, Increasing Web Site Visibility, Web Analytics Best Practices.	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Kogent Solution Inc. (Year). Java Server Programming Java EE6 (J2EE 1.6) Black Book.
2. Bayross, I. (Year). Web Enabled Commercial Application Using HTML, DHTML, JavaScript, Perl, CGI. BPB Publication.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	1	1	1						1		
CO2								1			
CO3	1								1		
CO4			1								
CO5								1	1		

**Data Mining Lab**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Data Mining using Python Lab
<b>Course Code</b>	BCAL-4003
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	IDC

<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Develop Python proficiency for data mining:</li> <li>2. Apply data mining techniques</li> <li>3. Evaluate and interpret mining results:</li> <li>4. Develop critical thinking and problem-solving skills.</li> <li>5. Collaborate effectively in a team</li> </ol>
<b>Course Outcome (COs)</b>	<p>CO1. Develop proficiency in Python for data mining: Students will gain a strong foundation in Python and</p> <p>CO2. Apply data mining techniques to real-world problems: Students will learn how to identify and apply appropriate data mining techniques</p> <p>CO3. Evaluate and interpret mining results: Students will develop the ability to evaluate and interpret the results of data mining algorithms.</p> <p>CO4. Develop critical thinking and problem-solving skills: Through the process of designing and implementing data mining solutions</p> <p>CO5. Collaborate effectively in a team: Students will have opportunities to work collaboratively in small groups on data mining projects</p>

### Course Outline

<b>Lab</b>	<b>Description</b>	<b>CO Mapping</b>
<b>Lab :1</b>	Introduction to Python <ul style="list-style-type: none"> <li>• Introduction to Python and its data mining libraries (e.g., NumPy, Pandas, Scikit-learn)</li> </ul>	<b>CO1</b>
<b>Lab :2</b>	<ul style="list-style-type: none"> <li>• Matrix Operations</li> </ul>	<b>CO1</b>
<b>Lab :3</b>	<ul style="list-style-type: none"> <li>• Linear Algebra on Matrices</li> </ul>	<b>CO2</b>
<b>Lab :4</b>	<ul style="list-style-type: none"> <li>• Understanding Data</li> </ul>	<b>CO2</b>
<b>Lab :5</b>	<ul style="list-style-type: none"> <li>• Correlation Matrix</li> </ul>	<b>CO2</b>
<b>Lab :6</b>	<ul style="list-style-type: none"> <li>• Data Cleaning and Outlier Detection and handling missing values</li> </ul>	<b>CO3</b>
<b>Lab :7</b>	Data Transformation and Normalization <ul style="list-style-type: none"> <li>• Data transformation techniques (e.g., data type conversion, data reduction)</li> <li>• Techniques for data normalization (e.g., min-max normalization, z-score normalization)</li> <li>• Implementation of data transformation and normalization using Python</li> </ul>	<b>CO3</b>
<b>Lab :8</b>	Mining Frequent Patterns and Associations <ul style="list-style-type: none"> <li>• Frequent pattern mining and association rule mining</li> <li>• Mining frequent patterns and associations using Python</li> </ul>	<b>CO4</b>

	<ul style="list-style-type: none"> <li>Evaluation and interpretation of mined patterns and associations</li> </ul>	
<b>Lab :9</b>	<b>Correlation Analysis and Constraint-Based Mining</b> <ul style="list-style-type: none"> <li>Correlation analysis and constraint-based mining</li> <li>Techniques for mining correlation rules and constrained patterns</li> <li>Implementation of correlation analysis and constraint-based mining using Python</li> </ul>	<b>CO4</b>
<b>Lab :10</b>	<b>Classification and Prediction</b> <ul style="list-style-type: none"> <li>Classification and prediction techniques</li> <li>Techniques for feature selection and model evaluation</li> <li>Implementation of classification and prediction using Python</li> </ul>	<b>CO5</b>
<b>Lab :11 -12</b>	<b>Cluster Analysis</b> <ul style="list-style-type: none"> <li>Cluster analysis and its applications</li> <li>Techniques for clustering data (e.g., K-means, hierarchical clustering, density-based clustering)</li> <li>Implementation of cluster analysis using Python</li> </ul>	<b>CO5</b>

**Evaluation:**

Mode of Evaluation	Laboratory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

**Text Book:**

1. Han, J., Kamber, M., & Pei, J. (2012). Data mining: concepts and techniques (3<sup>rd</sup> ed.). Morgan Kaufmann Publishers.

**Reference books:**

- Marsland, S. (2015). Machine learning: an algorithmic perspective (2nd ed.).
- Witten, I. H., Frank, E., & Hall, M. A. (2016). Data mining: practical machine with data.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2								1		
CO2		1	1						1		
CO3	2			1						1	
CO4	2							1			1
CO5	2								1		

## Internet and Web Technology Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	IV
<b>Course Title</b>	Internet and Web Technology Lab
<b>Course Code</b>	BCAL-4005
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	IDC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To introduce students to HTML and its various elements and their usage.</li> <li>2. To enable students to create static web pages using HTML and frames.</li> <li>3. To teach students the basics of cascading style sheets and their implementation in web pages.</li> <li>4. To familiarize students with JavaScript and its usage for validating forms.</li> <li>5. To introduce students to XML and its usage for data representation and exchange.</li> </ol>
<b>Course Outcome (COs)</b>	<p>CO1. Understand the concept of HTML and its various elements to create lists in a webpage.</p> <p>CO2. Demonstrate the ability to create hyperlinks and navigate between pages or sections of a webpage.</p> <p>CO3. Demonstrate the ability to create a timetable using tables and apply appropriate styling.</p> <p>CO4. Understand the concept of frames and create a static home page using frames.</p> <p>CO5. Demonstrate the ability to create a static registration form and validate it using JavaScript.</p>

### Course Outline

Lab	Description	CO Mapping
<b>Lab :1</b>	Write a HTML program for the demonstration of Lists. Unordered List , Ordered List, Definition List, Nested List	<b>CO1</b>
<b>Lab :2</b>	Write a HTML program for demonstrating Hyperlinks. <ul style="list-style-type: none"> <li>• Navigation from one page to another.</li> <li>• Navigation within the page</li> </ul>	<b>CO2</b>
<b>Lab :3</b>	Write a HTML program for time-table using tables.	<b>CO3</b>
<b>Lab :4</b>	<ul style="list-style-type: none"> <li>• Write a HTML program to develop a static Home Page using frames.</li> <li>• Write a HTML program to develop a static Registration Form.</li> <li>• Write a HTML program to develop a static Login Page</li> </ul>	<b>CO4</b>

<b>Lab :5</b>	<ul style="list-style-type: none"> <li>Write a HTML program to develop a static Web Page for Catalog.</li> <li>Write a HTML program to develop a static Web Page for Shopping Cart.</li> </ul>	<b>CO5</b>
<b>Lab :6</b>	<ul style="list-style-type: none"> <li>Write HTML for demonstration of cascading stylesheets.</li> <li>Embedded stylesheets.</li> <li>External stylesheets.</li> <li>Inline styles.</li> </ul>	<b>CO1, CO2</b>
<b>Lab :7</b>	Write a javascript program to validate USER LOGIN page.	<b>CO1, CO3</b>
<b>Lab :8</b>	Write a javascript program for validating REGISTRATION FORM	<b>CO1, CO4</b>
<b>Lab :9</b>	<ul style="list-style-type: none"> <li>Write a program for implementing XML document for CUSTOMER DETAILS.</li> <li>Write an internal Document Type Definition to validate XML for CUSTOMER DETAILS?</li> </ul>	<b>CO2, CO4</b>
<b>Lab :10</b>	Write a JSP that reads parameters from user login page.	<b>CO2, CO3</b>
<b>Lab :11</b>	Write a JSP that reads a value, creates a cookie and retrieves it.	<b>CO2, CO3</b>
<b>Lab :12</b>	Write a servlet that connects to the database and retrieves the data and displays it.	<b>CO3, CO4</b>

**Evaluation:**

Mode of Evaluation	Laboratory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

**Reference Materials:**

- Holzner, S. (Year). HTML Black Book. Publisher.
- Naughton, P., & Schildt, H. (Year). The Complete Reference Java 2 (5th ed.). TMH.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	1	1	1						1		
CO2								1			
CO3	1								1		
CO4			1								
CO5								1	1		

## Third Year

### Semester –V

#### Machine Learning

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	V
<b>Course Title</b>	Machine Learning
<b>Course Code</b>	BCAT-5001
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	IDC
<b>Course Objective</b>	The subject aims to provide the student with: 1. An understanding of basic concepts of Machine Learning. 2. An introduction to the fundamentals of Supervised Learning. 3. An understanding of Support Vector Machine. 4. An introduction to Evaluation. 5. An introduction to Unsupervised Learning. 6. An introduction to Deep Networks.
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO1. Explain Machine Learning as well as its needs. CO2. Explain Supervised Learning and its usage. CO3. Demonstrate the use of Support Vector Machine CO4. Understanding the concept of Deep Neural Networks and Convolution Neural Network CO5. Understanding the concept and implementation of Genetic Algorithms

#### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction:</b> Learning theory, Hypothesis and target class, Inductive bias and bias-variance tradeoff, Occam's razor, Approximation and estimation errors. Dimensionality reduction and Feature selection, PCA, <b>Model Evaluation:</b> Performance evaluation metrics, ROC Curves, Validation methods	CO1
<b>UNIT2</b>	<b>Supervised Learning:</b> Linear separability and decision regions, Linear discriminants, Bayesian's Theory, Classification and Regression Trees,	CO2

	Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, <b>k-nearest Neighbour Algorithm</b> <b>Artificial Neural Networks:</b> Introduction Mc-Culloch Pitts Neuron/ Perceptron Model, Multilayer Perception, Important terminologies of ANNs, Back Propagation	
<b>UNIT3</b>	<b>Support Vector Machines:</b> Structural and empirical risk, Margin of a classifier, Support Vector Machines, learning nonlinear hypothesis using kernel functions. <b>Decision Tree:</b> Decision Tree Induction, Overfitting, Pruning of decision trees Ensemble approach: Bagging and Boosting	CO3
<b>UNIT4</b>	<b>Introduction to Deep Networks:</b> Introduction to deep feed forward networks, convolutional neural networks, different terminologies related to CNN: stride, pooling, dropout, optimization techniques	CO4
<b>UNIT5</b>	<b>Genetic Algorithms:</b> Genetic Algorithms: Motivation, Genetic Algorithms: Representing Hypotheses, Genetic Operator, Fitness Function and Selection, An Illustrative Example, Hypothesis Space Search, Genetic Programming. Introduction to different optimization algorithms	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. E. Alpaydin, (2006) Introduction to Machine Learning, Prentice Hall of India.
2. T Hastie, R Tibshirani and J Friedman, (2009) The Elements of Statistical Learning Data Mining, Inference, and Prediction, 2nd Edition, Springer.

**Reference Books:**

1. C. M. Bishop, (2010) Pattern Recognition and Machine Learning, Springer.
2. R. O. Duda, P. E. Hart, and D.G. Stork, (2012) Pattern Classification, John Wiley and Sons.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2		1			1			1		
CO2		1		1							
CO3			1	1				1		1	
CO4		2		2		1			1		1
CO5	1						1				

## Software Engineering

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	V
<b>Course Title</b>	Software Engineering
<b>Course Code</b>	BCAT-5002
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	Core Course
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. An understanding of basic concepts of Software Engineering.</li> <li>2. An introduction to the fundamentals of Requirement Engineering.</li> <li>3. An understanding of Object-oriented design and UML.</li> <li>4. An introduction to Architectural Design.</li> <li>5. An introduction to Project Management.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <ol style="list-style-type: none"> <li>CO1. Explain the needs of Software Engineering.</li> <li>CO2. Explain the working and importance of Requirement Engineering.</li> <li>CO3. Demonstrate the use of object-oriented design and UML.</li> <li>CO4. Explain the flow of Architectural Design.</li> <li>CO5. Explain the need of Project Management.</li> </ol>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction:</b> Introduction to Software Development processes, Agile software development: Agile methods, Plan-driven and agile development, Extreme programming, Agile Process model: Adoptive software development, scrum, crystal, Agile modelling, Agile unified process.	CO1
<b>UNIT2</b>	<b>Requirements engineering:</b> Functional and non-functional requirements: The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management	CO2
<b>UNIT3</b>	<b>Function oriented Software Design:</b> SA/SD Methodology, Data Flow Diagrams, Structured Design Transformation of DFD into Structure chart, Transformation and Transaction Analysis <b>Object-oriented design using UML:</b> Analysis and Design: Concepts, Classes and Objects. Relationships Among Objects. Inheritance and Polymorphism, Design Concepts, Design Notation and Specification,	CO3

	Design Methodology, Dynamic Modelling, Functional Modelling, Defining Internal Classes and Operations, Design patterns.	
<b>UNIT4</b>	<b>System modelling:</b> Context models, Interaction models, Structural models, Behavioural models Model-driven engineering. <b>Architectural Design:</b> Architectural design decisions, Architectural views, Architectural patterns, Application architectures, Design and implementation, <b>Testing:</b> Introduction to software testing, verification and validation, unit testing, integration testing, system testing. Software Maintenance.	CO4
<b>UNIT5</b>	<b>Project Management:</b> Introduction to Risk management, managing people, Teamwork, Project planning, Software pricing, Plan-driven development, Project scheduling, Estimation techniques, Quality management, Software measurement and metrics. Introduction to Advanced Software Engineering concepts: Software reuse, Component-based software engineering, Distributed software engineering, Service-oriented architecture, Embedded software, Aspect-oriented software engineering	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Rajib Mall, (2018) Fundamentals of Software Engineering-, PHI, New Delhi. 5th Edition,
2. Roger S. Pressman, Bruce R. Maxim, (2019) Software Engineering-A practitioner's approach-McGraw-Hill International Editions, New York. ISBN: 9789353165710, 9353165717, Edition: 8,

**Reference Books:**

1. Ugrasen Suman, (2013) Software Engineering: Concepts & Practices, Cengage Learning publications. 1st Edition,
2. Aggarwal, K. K. & Singh, Y: Software Engineering (New Age International)

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								1		
CO2			1			1	1	1			
CO3		2	1							1	
CO4		1					1	1			
CO5					1				1		

## Machine Learning Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	V
<b>Course Title</b>	Machine Learning Lab
<b>Course Code</b>	BCAL-5001
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	IDC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. An understanding of basic concepts of Machine Learning.</li> <li>2. An introduction to the fundamentals of Supervised Learning.</li> <li>3. An understanding of Support Vector Machine.</li> <li>4. An introduction to Evaluation.</li> <li>5. An introduction to Unsupervised Learning.</li> <li>6. An introduction to Deep Networks.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the import and export of data using python.</p> <p>CO2. Demonstrate the various data pre-processing and dimension reduction methods</p> <p>CO3. Demonstrate the linear regression model and implement the different classification techniques</p> <p>CO4. Understanding the concept of Deep Neural Networks and Convolution Neural Network</p> <p>CO5. Understanding the concept and implementation of Genetic Algorithms</p>

### Course Outline

<b>Lab</b>	<b>Description</b>	<b>CO Mapping</b>
<b>Lab :1</b>	Write a python program to import and export data using Pandas library functions	<b>CO1</b>
<b>Lab :2</b>	Demonstrate various data pre-processing techniques for a given dataset	<b>CO2</b>
<b>Lab :3</b>	Implement Dimensionality reduction using Principle Component Analysis (PCA) method.	<b>CO2</b>
<b>Lab :4</b>	Write a Python program to demonstrate various Data Visualization Techniques.	<b>CO3</b>
<b>Lab :5</b>	Implement Simple and Multiple Linear Regression Models.	<b>CO3</b>

<b>Lab :6</b>	Develop Logistic Regression Model for a given dataset.	<b>CO3</b>
<b>Lab :7</b>	Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.	<b>CO4</b>
<b>Lab :8</b>	Implement Naïve Bayes Classification in Python	<b>CO5</b>
<b>Lab :9</b>	Build KNN Classification model for a given dataset.	<b>CO4</b>
<b>Lab :10</b>	Build Artificial Neural Network model with back propagation on a given dataset.	<b>CO4</b>
<b>Lab :11</b>	Build CNN Model on given data set	<b>CO4</b>
<b>Lab :12</b>	Implementation of Genetic Algorithm	<b>CO5</b>

**Evaluation:**

Mode of Evaluation	Laboratory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

**Reference Books:**

1. C. M. Bishop, (2010)Pattern Recognition and Machine Learning, Springer.
2. R. O. Duda, P. E. Hart, and D.G. Stork, (2012)Pattern Classification, John Wiley and Sons,.

0.00 CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2		1			1			1		
CO2		1		1							
CO3			1	1				1		1	
CO4		2		2		1			1		1
CO5	1						1				

**Social Responsibly and Community Engagement**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	Data Science
<b>Semester</b>	V
<b>Course Title</b>	Social Responsibly /Community Engagement
<b>Course Code</b>	BCAT-5005
<b>Credit</b>	1 (0-0-2)

<b>Course Type</b>	
<b>Course Objective</b>	<p>1. To make students understand different problems faced by the people in different sections of society.</p> <p>2. To connect their class-room learning with problem solving skills in real life scenario.</p>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1: Identify social problems prevailing in different sections of society and finding the solution in sustainable manner.</p> <p>CO2: Get practical exposure of all round development which complements their class room learning</p> <p>CO3: Make survey, collect data, analyze data and will extract results out of it to correlate with their theoretical knowledge.</p> <p>CO4: Identify the common problems of the rural people and will provide cost effective solution.</p> <p>CO5: Analyze survey data and analyzed results will be reported to concerned authority.</p>
<b>Guidelines</b>	<p>8. Maximum 10 students in each group.</p> <p>9. A faculty guide will be assigned to each group.</p> <p>10. Students will prepare project title, questionnaire and final report under the guidance of the faculty guide.</p> <p>11. The topic of the research should be related to social, economic or environmental issues concerning the common man.</p> <p>12. The report should contain 2,500 to 3,000 words and relevant charts, tables and photographs.</p>
<b>Layout of Report</b>	<p style="text-align: center;"><b>Title</b></p> <p style="text-align: center;"><b>Abstract (250 words)</b></p> <p style="text-align: center;">a. Introduction</p> <p style="text-align: center;">b. Literature review(optional)</p> <p style="text-align: center;">c. Objective of the research</p> <p style="text-align: center;">d. Research Methodology</p> <p style="text-align: center;">e. Finding and discussion</p> <p style="text-align: center;">f. Conclusion and recommendation</p> <p style="text-align: center;">g. References</p>
<b>Format</b>	Will be provided by faculty guide

### Evaluation:

Mode of Evaluation	Practical	
Weightage	Continuous Evaluation	End Semester Examination
	40 (field visit, data collection, report writing etc.)	60 (final report, presentation and viva)

## Semester -VI

### Theory of Computation

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VI
<b>Course Title</b>	Theory of Computation
<b>Course Code</b>	BCAT-6001
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"><li>1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages</li><li>2. To illustrate finite state machines to solve problems in computing</li><li>3. To explain the hierarchy of problems arising in the computer sciences.</li><li>4. To familiarize Regular grammars, context free grammar.</li></ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO1. To use basic concepts of formal languages of finite automata techniques CO2. Construct automata theory using Finite Automata CO3. Construct context free grammar for various languages CO4. Design context free grammar and Pushdown Automata CO5. Explain Turing machine for computational functions

#### Course Outline

<b>UNIT 1</b>	<b>Introduction to TOC</b> Mathematical Preliminaries and Notation, Three Basic Concepts (Languages, Grammars and Automata) Some Applications.
<b>UNIT 2</b>	<b>Finite Automata and its types</b> Deterministic Finite Automata/ Accepters (DFA), Nondeterministic Finite Accepters (NFA), Equivalence of DFA and NFA, Reduction of the number of states in Finite Automata, FA with output: Mealy and Moore machine Equivalence between Mealy machine and Moore machine
<b>UNIT 3</b>	<b>Languages and Grammars</b> Grammar and Formal Languages, Chomsky Hierarchy, Regular Expressions and Finite Automata, Regular Grammar, Properties of Regular Languages, Identifying Non-Regular Languages, Pumping Lemma for Regular Languages
<b>UNIT 4</b>	<b>Context Free Languages</b> Context Free Languages, Leftmost and Rightmost Derivations, Derivation trees, Parsing and Ambiguity, Context Free Grammars, Simplification of

	Context Free Grammars and Normal Forms, Chomsky Normal Form (CNF), Greibach Normal Form (GNF), Pushdown Automata (PDA) and Context-Free Languages, Deterministic Pushdown Automata, Nondeterministic Pushdown Automata, Design of DPDA, NPDA, Conversion between PDA and CFG, Linear Bounded Automata and Context-Sensitive Languages
<b>UNIT 5</b>	<b>Turing Machines</b> Turing Machine and Recursive, Recursive Enumerable Languages, The Standard Turing Machine and variants of Turing Machine, Solving Some Problems by using Turing Machine, Problems that cannot be solved by Turing Machine, Halting Turing machine, PCP Problem, etc. Design of DTM, NTM, Recursive and Recursively Enumerable Languages, Unrestricted Grammars, Context Sensitive Grammars and Languages, The Chomsky Hierarchy revisited

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Hopcroft J.E., Motwani R. & Ullman J.D., (2008)"Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education.
2. John C Martin ,( 2011) "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill.

**Reference Books:**

1. Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, 2015.
2. Peter Linz,( 2016) "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett,.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	1							2		
CO2	1	1									
CO3				1						1	
CO4	1						1				
CO5			1					1			1

## Cloud Computing

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VI
<b>Course Title</b>	Cloud Computing
<b>Course Code</b>	BCAT-6001
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with:
<b>Course Outcome (COs)</b>	<p>CO1. After completion of this course students will be able to: Analyses the phases of transition from classic data center to virtual data center and then to the cloud.</p> <p>CO2. Describe virtualization technology at compute, storage, network, desktop, and application layers of IT infrastructure.</p> <p>CO3. Implement the key characteristics, services, and deployment models of cloud.</p> <p>CO4. Elaborated the cloud infrastructure components and service management processes. Illustrate the cloud security concerns and solutions.</p> <p>CO5. Demonstrate the entrepreneurship skill by key considerations for migration to the cloud and Implement business continuity solutions in a VDC environment and hence improve employability skills.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	Introduction to Cloud Computing, Evolution, Benefits and Barriers, Cloud SPI models, Cloud Computing Vs Cluster Computing, Technology Involved in Cloud Computing, NIST Cloud architecture, Modern Cloud architecture, Cloud Characteristics, Service Model and Deployment Model, Types of hypervisors.	CO1
<b>UNIT2</b>	Data and Network Management- Introduction- Objectives, Classic datacenters (CDCs) technologies, Virtualised Data Centers (VDCs), Storage Virtualization, Virtual Machine Storage Options, Block & File level Storage Virtualization, Virtual Provisioning, Compute Virtualisation, Virtual Machine Components, Compute Virtualisation Techniques,	CO2

	Converting Physical Machines to Virtual Machines, Desktop and Application	
<b>UNIT3</b>	Virtualisation: Virtualized Data Center– Networking- Network virtualization in VDC, VDC network infrastructure and components, Virtual LAN (VLAN) and Virtual SAN (VSAN), Components of VDC Network Infrastructure, Virtual Network Component, VLAN and VSAN Technologies, Network traffic management techniques in VDC Service.	CO3
<b>UNIT4</b>	Management in Cloud Computing, Service Level Agreements (SLAs), Quality of Service (QoS), Billing and Accounting, Scaling Cloud Hardware, Managing Data, Cloud Security and Privacy, Infrastructure security, Data security and Storage, Data privacy, access management	CO4
<b>UNIT5</b>	Cloud computing standards and Interoperability, technical considerations for migration to the cloud. Migrating to the Cloud-Introduction- Objectives, Cloud Services for individuals- Available Services - Skytap Solution, Cloud Services Aimed at the mid – market, Live Migration. Case Studies.	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Miller M, (2008) Cloud Computing, 8th Edition, Que Publishers.
2. Buyya R K, (2011) Cloud Computing: Principles and Paradigms, Wiley Press.

### Reference Books

1. K Saurabh, Cloud Computing, 2nd Edition, Wiley India
2. V Joysula, M Orr, G Page, (2012) Cloud Computing: Automating the Virtualized Data Center: Cisco Press.
3. Mei- Ling Liu, (2004) “Distributed Computing: Principles and Application”, Pearson Education, Inc. New Delhi.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2		1								1
CO2		1								1	
CO3			1					1			
CO4				1			2	1	2		

## Cloud Computing Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VI
<b>Course Title</b>	Cloud Computing Lab
<b>Course Code</b>	BCAL-6002
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	CC
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To learn to use version control systems</li> <li>2. To create web applications in the cloud</li> <li>3. To learn about virtual machines and work with them</li> <li>4. To learn how to design and build a cloud-based application.</li> <li>5. To learn how to use Hadoop to implement and use parallel programming</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Configure various virtualization tools such as Virtual Box, VMware workstation.</p> <p>CO2. Design and deploy a web application in a PaaS environment.</p> <p>CO3. Learn how to simulate a cloud environment to implement new schedulers.</p> <p>CO4. Install and use a generic cloud environment that can be used as a private cloud.</p> <p>CO5. Install and use Hadoop</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>Lab-1</b>	Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows	CO1
<b>Lab-2</b>	Pro Install a C compiler in the virtual machine created using virtual box and execute Simple Programs	CO2
<b>Lab-3</b>	Install Google App Engine. Create hello world app and other simple web applications using python/java.	CO2
<b>Lab-4</b>	Use GAE launcher to launch the web applications	CO2
<b>Lab-5</b>	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.	CO2

<b>Lab-6 -7</b>	Find a procedure to transfer the files from one virtual machine to another virtual machine.	CO3
<b>Lab-8-9</b>	Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)	C04
<b>Lab-10-12</b>	Install Hadoop single node cluster and run simple applications like word count.	CO4, CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	60	40

**Text Books:**

1. Mishra, A., & Mohanty, S. P. (2018). Cloud computing: principles and paradigms. John Wiley and Sons.
2. Judith S. Hurwitz, Daniel Kirsch ,(2020),Cloud Computing for Dummies,

**Reference Books:**

1. Jamsa, K. A. (2018). Cloud computing: SaaS, PaaS, IaaS, virtualization, business models, mobile, security and more. Jones Bartlett Learning.
2. Marinescu, D. C. (2013). Cloud computing: theory and practice. Morgan Kaufmann.  
Kumar, P.; Rai, A. K. (2018). Cloud computing: concepts, technology and architecture. John Wiley Sons.

## Fourth Year

### Semester – VII

#### Research Methodology

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VII
<b>Course Title</b>	Research Methodology
<b>Course Code</b>	BCAT-7001
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: 1. To acquaint students with the concepts of Survey and Research and provide inputs relating to research methodology, the process of research report writing.

<b>Course Outcome (COs)</b>	After completion of this course students will be able to: CO1. Understand Meaning of Research and role of research in various functional areas; CO2. Formulate hypothesis and research design; CO3. Identify Methods of Data collection and pilot study; CO4. Develop Processing and Analysis of data; CO5. Apply Report writing techniques and draft research reports.
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### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction to Research:</b> The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research, Meaning and types of Research hypothesis, Importance of Review of Literature, Organizing the Review of Literature.	CO1
<b>UNIT2</b>	<b>Types of Research:</b> Types of research, pure (basic, fundamental) and applied research, qualitative and quantitative. Research Design: Meaning, need, types of research design – Exploratory, Descriptive, Casual research Design, Components of research design, and Features of good Research design. Experiments, surveys and case study Research design.	CO2
<b>UNIT3</b>	<b>Sampling, Data Collection and analysis:</b> Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties. Statistical Methods for Data Analysis: Applications of Statistics in Research, measures of central tendency and dispersion	CO3
<b>UNIT4</b>	<b>Research Report:</b> Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Thesis and Dissertations, components of thesis and dissertations. Referencing styles and bibliography.	CO4
<b>UNIT5</b>	<b>Ethics in Research and Tools for Research:</b> Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher. Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools. Web search : Introduction to Internet, use of Internet and WWW, using search engines and advanced search tools.	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Cooper, D. R. & Schindler, P. S., Business Research Methods.
2. Boston, Mass.: McGraw-Hill/Irwin

**Reference Books:**

3. Greene, W. H., Econometric Analysis. Pearson Pvt. limited
4. Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin . Business Research Methods.  
Cengage Learning limited

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	2							2		
CO2			2	1						2	
CO3		1			1	2					
CO4		1				2		2			

**Data Visualization and Interpretation**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VII
<b>Course Title</b>	Data Visualization and Interpretation
<b>Course Code</b>	BCAT-7002
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	IDC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>2. Understand the principles of data visualization:</li> <li>3. Develop skills in data preparation for visualization:</li> <li>4. Create effective visualizations and to incorporate visual cues for data interpretation with clarity and accuracy of visualizations.</li> <li>5. Learn about interactive data visualization: Students will be introduced to interactive data visualization, including tools and libraries for interactive visualization.</li> </ol>

<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO6. Understand the importance and purpose of data visualization, and the role it plays in data analysis and decision-making.</p> <p>CO7. Gain proficiency in a range of data visualization tools and technologies, and learn how to choose the appropriate tool for a given data set and task.</p> <p>CO8. Develop skills in a variety of visualization techniques for exploring and communicating different types of data, including distributions, correlations, and multivariate relationships.</p> <p>CO9. Apply design principles and best practices to create effective charts, graphs, and infographics that accurately and clearly communicate insights and findings from data.</p> <p>CO10. Develop an ethical and critical understanding of the challenges and limitations of data visualization, including issues of bias, representation, and interpretation.</p>
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### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	Introduction to Data Visualization, Principles of data visualization, Types of charts and graphs, Choosing the appropriate chart for different types of data, Introduction to data interpretation	CO1
<b>UNIT2</b>	Data Preparation for Visualization, Understanding the importance of data preparation, Data cleaning and filtering techniques, Transforming and aggregating data, Handling missing values	CO2
<b>UNIT3</b>	Creating Effective Visualizations, Designing effective visualizations, Best practices for creating charts and graphs, Incorporating visual cues for data interpretation, Enhancing the clarity and accuracy of visualizations	CO3
<b>UNIT4</b>	Interactive Data Visualization, Introduction to interactive data visualization, Using tools and libraries for interactive visualization, Adding interactivity to static visualizations, Designing interactive dashboards	CO4
<b>UNIT5</b>	Data Interpretation and Communication, Interpretation and analysis of visualized data, Communicating data insights effectively, Storytelling with data, Ethical considerations in data visualization and communication	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Wilkinson, L. (2012). *The grammar of graphics* (pp. 375-414). Springer Berlin Heidelberg.

2. Campbell A (2022). *Data Visualization: Ultimate Guide to Data Mining and Visualization*.

**Reference Books:**

5. Knaflic, C. N. (2015). *Storytelling with data: A data visualization guide for business professionals*. John Wiley & Sons

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	2							2		
CO2			2	1						2	
CO3		1			1	2					
CO4		1				2		2			
CO5							1				2

**Quantum Computing**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Quantum Computing
<b>Course Code</b>	BCAT-7003
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. The objective of this course is to provide a strong foundation in quantum computing theory and practical applications.</li> <li>2. It introduces the basic principles of quantum mechanics, qubits, circuit model of quantum computing etc and provides a hands-on experience on programming quantum computer using IBM Qiskit.</li> <li>3. It also includes an introduction to quantum machine learning</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1: The objective of this course is to provide a strong foundation in quantum computing theory and practical applications.</p> <p>CO2: It introduces the basic principles of quantum mechanics, qubits, and the circuit model of quantum computing.</p> <p>CO3: It provides hands-on experience in programming quantum computers using IBM Qiskit.</p> <p>CO4: It also includes an introduction to quantum machine learning.</p> <p>CO5: It provides hands-on experience in programming quantum machine learning algorithms using IBM Qiskit.</p>

## Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	Quantum Computation: History & Overview, Review of linear algebra: Dirac notation, Hilbert spaces, Unitary, Hermitian, and Normal matrices, Inner product, Outer product, Tensor product, Postulates of Quantum Mechanics, Stern and Gerlach experiment, Qubit, Bloch Sphere	CO1
<b>UNIT2</b>	Circuit model of Quantum Computing: Quantum gates and Circuit, Entanglement: Bell state, Quantum Teleportation, Superdense coding, Phase kickback, No-cloning theorem, Quantum parallelism, Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm, Grover search algorithm	CO2
<b>UNIT3</b>	Qiskit programming: Introduction to Qiskit, building and running quantum circuits, practical examples of implementing basic algorithms on Qiskit.	CO3
<b>UNIT4</b>	Advanced Quantum Algorithms and Error Correction: Quantum Fourier Transform, Quantum Phase Estimation, Shor's algorithm, Quantum Error Correction, Gottesman-Knill Theorem, Surface codes	CO4
<b>UNIT5</b>	Quantum Machine Learning: Data encoding – Basis encoding, Amplitude encoding, Hamiltonian Encoding, Swap test, Q-means clustering.	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Textbook:

1. David McMahon, "Quantum Computing Explained", Wiley-IEEE Computer Society Press, 2007.
2. Maria Schuld, Francesco Petruccione, "Machine Learning with Quantum Computers", Springer International Publications, 2021.
3. Venkateswaran Kasirajan, "Fundamentals of Quantum Computing -Theory and Practice", Springer, 2021.

### Reference Books:

1. Nielsen MA, Chuang IL. "Quantum computation and quantum information".Cambridge university press;2010 Dec 9.
2. Eleanor Rieffel and Wolfgang Polak, "Quantum Computing: A Gentle Introduction",2011 Edition, MIT Press.
3. Chris Bernhardt, "Quantum Computing for Everyone (The MIT Press)",2019.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	2							2		

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

### Software Project Management

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Software Project Management
<b>Course Code</b>	BCAT-7004
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. Understanding the specific roles within a software organization as related to project and process management</li> <li>2. Understanding the basic infrastructure competences (e.g., process modeling and measurement)</li> <li>3. Understanding the basic steps of project planning, project management, quality assurance, and process management and their relationships.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <p>CO1. Describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project</p> <p>CO2. Compare and differentiate organization structures and project structures.</p> <p>CO3. Implement a project to manage project schedule, expenses and resource with the application of suitable project management tools</p>

### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	Conventional Software Management: The waterfall Model, Conventional Software Management Performance, Evolution of Software Economics: software Economics. Pragmatic Software Cost Estimation. Improving Software Economics: Reducing Software Product Size, Improving Software Processes, Improving Team Effectiveness, Improving Automation, Achieving Required Quality, Peer Inspections.	CO1
<b>UNIT2</b>	Conventional and Modern Software Management: Principles of Conventional Software Engineering, Principles of Modern Software Management, Transitioning to an interactive Process.	CO2

	Life Cycle Phases: Engineering and Production Stages Inception, Elaboration, Construction, Transition phases.	
<b>UNIT3</b>	Artifacts of the Process: The Artifact Sets. Management Artifacts, Engineering Artifacts, Programmatic Artifacts. Model Based Software Architectures: A Management Perspective and Technical Perspective.	CO3
<b>UNIT4</b>	Flows of the Process: Software Process Workflows. Inter Trans Workflows. Checkpoints of the Process: Major Mile Stones, Minor Milestones, Periodic Status Assessments. Interactive Process Planning: Work Breakdown Structures, Planning Guidelines, Cost and Schedule Estimating. Interaction Planning Process, Pragmatic Planning.	CO4
<b>UNIT5</b>	Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, and Evolution of Organizations. Process Automation: Building Blocks, the Project Environment. Project Control and Process Instrumentation: Server Care Metrics, Management Indicators, Quality Indicators, Life Cycle Expectations Pragmatic Software	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Textbook:

1. Walker Rayce, "Software Project Management", 1998, PEA.
2. Henry, "Software Project Management", Pearson.

### Reference Books:

1. Richard H. Thayer. "Software Engineering Project Management", 1997, IEEE Computer Society.
2. Shere K.D.: "Software Engineering and Management", 1998, PHI.
3. S.A. Kelkar, "Software Project Management: A Concise Study", PHI.
4. Hughes Cotterell, "Software Project Management", 2e, TMH. 88
5. Kaeron Conway, "Software Project Management from Concept to D

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	2							2		
CO2			2	1						2	
CO3		1			1	2					
CO4		1				2		2			
CO5							1				2

## Cryptography and Network Security

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VII
<b>Course Title</b>	Cryptography and Network Security
<b>Course Code</b>	BCAT-7005
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Develop a clear understanding of the need for security in computer systems.</li> <li>2. Understand the principles of symmetric ciphers and how they are used to encrypt and decrypt data.</li> <li>3. Learn about public key cryptography and the principles behind it, including the RSA algorithm, key distribution and management, and the Diffie-Hellman key exchange.</li> <li>4. Understand the requirements of authentication and different methods used to achieve it, including message authentication codes, hashes, and user authentication methods such as passwords, certificates, and biometrics.</li> <li>5. Understand network security and how it is implemented, including the use of firewalls, IP security, VPNs, intrusion detection systems, web security, SSL, and TLS.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the need for security in computer networks, be able to identify different types of security attacks, and describe various security services and mechanisms.</p> <p>CO2. Demonstrate knowledge of symmetric ciphers, including substitution and transposition techniques, block ciphers such as DES and Triple DES, and stream ciphers like RC4.</p> <p>CO3. Understand the principles and need for public key cryptography, including RSA algorithm, key distribution, and management.</p> <p>CO4. Develop knowledge of different authentication requirements, including message authentication codes, hashes, and digital signatures.</p> <p>CO5. Understand network security concepts, including firewalls, IP security, virtual private networks (VPN), intrusion detection, web security, SSL, and TLS.</p>

### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	<b>Introduction:</b> Need for Security, Security Attacks, Services and Mechanisms. Network Security Model	CO1
<b>UNIT2</b>	<b>Symmetric Ciphers:</b> Substitution & Transposition Techniques, Block Cipher, DES, Triple DES, Stream Ciphers, RC4	CO2
<b>UNIT3</b>	<b>Public Key Cryptography:</b> Need and Principles of Public Key Cryptosystems, RSA Algorithm, Key Distribution and Management, Diffie-Hellman Key Exchange, Digital Signatures	CO3
<b>UNIT4</b>	<b>Authentication:</b> Authentication Requirements, Message Authentication Codes, Hashes, MD5 & SHA, User Authentication: Password, Certificate based & Biometric Authentication, Kerberos	CO4
<b>UNIT5</b>	<b>Network Security:</b> Firewalls, IP Security, VPN, Intrusion Detection, Web Security, SSL, TLS	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. W.Stalings- (2000.)Cryptography and Network Security Principles and Practice, Person Education Asia, (3rd Edition)
2. D.Stinsori,( 2006) Cryptography: Theory and Practice, CRC press,.

**Reference Books:**

1. B. Schneier(1996) Applied Cryptography, New York, Wiley.
2. N.Koblitz: a course in number theory and cryptography, Springer verlag.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2		1						2		
CO2		2		1							
CO3							1	1			
CO4						1				2	
CO5				1				2			1

## Data Visualization and Interpretation - Lab

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	VII
<b>Course Title</b>	Data Visualization and Interpretation - Lab
<b>Course Code</b>	BCAL-7002
<b>Credit</b>	L-T-P- 0-0-2 Total Credit - 1
<b>Course Type</b>	IDC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. This course will introduce the main concepts of visual analytics with a hands-on tutorial using Tableau, a leading self-service data visualization tool.</li> <li>2. It aims at learning about how to create effective charts and interactive dashboards will provide the student a very useful skill applicable in many business scenarios.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand and describe the main concepts of data visualization</p> <p>CO2. Create ad-hoc reports, data visualizations, and dashboards using Tableau Desktop</p> <p>CO3. Publish the created visualizations to Tableau Server and Tableau Public</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>Lab 1-2</b>	<p>Introduction to Tableau:</p> <ul style="list-style-type: none"> <li>• Course introduction</li> <li>• Dataviz best practices</li> <li>• Getting started with Tableau Desktop</li> <li>• Connecting to the tutorial dataset</li> <li>• Creating the first charts</li> <li>• Filtering and sorting data</li> </ul>	CO1
<b>Lab 3-4</b>	<p>Common charts:</p> <ul style="list-style-type: none"> <li>• Creating common visualizations (bar charts, line charts etc.)</li> <li>• Assembling a dashboard layout</li> <li>• Using dashboard filters</li> </ul>	CO2
<b>Lab 5-6</b>	<p>Transform the data:</p> <ul style="list-style-type: none"> <li>• Dataviz best practices</li> <li>• Creating simple calculations in Tableau</li> <li>• Using table calculations</li> </ul>	CO2

<b>Lab 7-8</b>	Interactions <ul style="list-style-type: none"> <li>• Interactivity with text and visual tooltips</li> <li>• Interactivity with actions (filter, highlight, URL)</li> <li>• Drilldown between dashboards</li> </ul>	CO2
<b>Lab 9-10</b>	Advanced visualizations <ul style="list-style-type: none"> <li>• Dataviz best practices</li> <li>• Creating more advanced chart types</li> <li>• Using multiple source tables</li> </ul>	CO3
<b>Lab 11-12</b>	Data Storytelling <ul style="list-style-type: none"> <li>• Intro to data storytelling</li> <li>• Creating a data story in Tableau</li> <li>• Overview of the Tableau ecosystem</li> <li>• Further learning opportunities</li> </ul>	CO3

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Evaluation
	60	40

System Requirements: System requirements are listed here under Tableau Desktop and Tableau Prep: <https://www.tableau.com/products/techspecs>.

The latest version of Tableau Desktop as well as Tableau Prep should be downloaded and installed from here: <https://www.tableau.com/tft/activation>

**TEXTBOOK:**

1. Tamara Munzner (2014), Visualization Analysis & Design (ISBN 9781466508910)

**REFERENCES BOOKS:**

1. Scott Murray, (2017) Interactive Data Visualization for the Web by 2nd Edition
2. Jacques Bertin (2010), Semiology of Graphics

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								2		
CO2		1	1			1				1	
CO3				2			1	1			1

**ELECTIVES****Computer Vision**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Computer Vision
<b>Course Code</b>	BCA
<b>Credit</b>	
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Understand the basic concepts and applications of computer vision, including its history and evolution, image formation, and sensing.</li> <li>2. Learn about image processing techniques such as point processing operations, histogram processing, and image filtering, and their use in enhancing images.</li> <li>3. Gain knowledge of feature extraction and analysis techniques used in computer vision, including feature matching algorithms, object recognition and detection, and object tracking.</li> <li>4. Understand the role of machine learning in computer vision, including supervised and unsupervised learning techniques, deep learning models such as CNNs and RNNs, and transfer learning.</li> <li>5. Explore the real-world applications of computer vision, including medical imaging, surveillance and security, autonomous vehicles and drones, and virtual and augmented reality.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the definition, scope, and applications of Computer Vision, and the evolution of Computer Vision over time.</p> <p>CO2. Develop a working knowledge of image formation, sensing, and basic image processing techniques.</p> <p>CO3. Understand and apply feature extraction techniques, feature matching algorithms, and object recognition and detection methods in Computer Vision.</p> <p>CO4. Develop a deep understanding of machine learning techniques such as supervised and unsupervised learning, and transfer learning, and apply them to Computer Vision problems.</p> <p>CO5. Develop a practical understanding of the real-world applications of Computer Vision.</p>

**Course Outline**

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction to Computer Vision:</b> Definition and scope of Computer Vision, History and evolution of Computer Vision:	CO1

	Applications of Computer Vision, Image Formation and Sensing, Image Processing Basics	
<b>UNIT2</b>	<b>Image Processing Techniques:</b> Point processing operations, Histogram processing, Image filtering, Edge detection. Image segmentation	CO2
<b>UNIT3</b>	<b>Feature Extraction and Analysis:</b> Feature extraction techniques, Feature matching algorithms, Object recognition and detection, Object tracking,	CO3
<b>UNIT4</b>	<b>Machine Learning in Computer Vision:</b> Introduction to machine learning in Computer vision, Supervised and unsupervised learning techniques, Deep learning models in computer vision (CNNs, RNNs, etc.), Transfer learning	CO4
<b>UNIT5</b>	<b>Applications of Computer Vision:</b> Real-time computer vision systems, medical imaging, Surveillance and security, Autonomous vehicles and drones, Virtual and augmented Reality	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Suggested Books:**

- Behrouz A. Forouzan & Richard F. Gilberg, "A structured Programming Approach Using C Forsyth, D. A., & Ponce, J. (2012). Computer Vision: A Modern Approach. Prentice Hall.

**Reference Books:**

- Prince, S. J. D. (2012). Computer Vision: Models, Learning, and Inference. Cambridge University Press.
- Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.
- Hartley, R. I., & Zisserman, A. (2004). Multiple View Geometry in Computer Vision. Cambridge University Press.
- Bradski, G., & Kaehler, A. (2008). Learning OpenCV: Computer Vision with the OpenCV Library. O'Reilly Media.
- Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2		1						1		
CO2	2										

CO3	1									1	
CO4				2							
CO5	2					1	1	1			

### Mobile App Development

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Mobile Application Development
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. To facilitate students to understand android SDK</li> <li>2. To help students to gain a basic understanding of Android application development</li> <li>3. To inculcate working knowledge of Android Studio development tool</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <ol style="list-style-type: none"> <li>CO1. Identify various concepts of mobile programming that make it unique from programming for other platforms,</li> <li>CO2. Critique mobile applications on their design pros and cons,</li> <li>CO3. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces,</li> <li>CO4. Program mobile applications for the Android operating system that use basic and advanced phone features,</li> <li>CO5. Deploy applications to the Android marketplace for distribution.</li> </ol>

### Course Outline

Unit	Description	CO Mapping
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<b>UNIT1</b>	Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.	CO1
<b>UNIT2</b>	Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions	CO2
<b>UNIT3</b>	Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.	CO3
<b>UNIT4</b>	Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources	CO4
<b>UNIT5</b>	Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Lauren Darcey and Shane Conder, (2011) “Android Wireless Application Development”, Pearson Education, 2nd ed.

### Reference Books:

1. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd
2. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	1						1	1		

CO2		1								
CO3		1	1		1					1
CO4							1	1		
CO5						1		1		1

### High Performance Computing

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	High Performance Computing
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Define and explain the concept of high-performance computing, its historical development.</li> <li>2. Understand the components of high-performance computing systems and their roles.</li> <li>3. Identify different types of parallel computing architectures and programming paradigms.</li> <li>4. Explore the architecture and types of high-performance computing clusters.</li> <li>5. Acquire knowledge of high-performance computing platforms and tools, including their evaluation and analysis.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the fundamental concepts of High Performance Computing.</p> <p>CO2. Identify different types of parallel computing and understand the parallel computing architecture and parallel processing models.</p> <p>CO3. Analyze cluster architecture, cluster types and topologies.</p> <p>CO4. Utilize various high-performance computing platforms and tools.</p>

	CO5. Apply High Performance Computing in scientific and engineering applications, artificial intelligence and machine learning, big data analytics, and cloud computing.
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Unit	Description	CO Mapping
<b>UNIT1</b>	<b>Introduction to High Performance Computing:</b> Definition and concepts of High Performance Computing, Historical development of High Performance Computing, Components of High Performance Computing systems, Applications of High Performance Computing	CO1
<b>UNIT2</b>	<b>Parallel Computing:</b> Types of Parallel Computing, Parallel Computing Architecture, Parallel Processing Models, Parallel Programming Paradigms	CO2
<b>UNIT3</b>	<b>High Performance Computing Clusters:</b> Cluster Architecture, Cluster Types and Topologies, Parallel Programming in Clusters, Job Scheduling and Resource Management in Clusters	CO3
<b>UNIT4</b>	<b>High Performance Computing Platforms and Tools:</b> High Performance Computing Platforms, Performance Evaluation and Analysis, High Performance Computing Tools and Libraries MPI and OpenMP Programming Models	CO4
<b>UNIT5</b>	<b>Applications of High Performance Computing:</b> Scientific and Engineering Applications, Artificial Intelligence and Machine Learning Applications, Big Data Analytics, Cloud Computing and High Performance Computing, Future of High Performance Computing.	CO5

#### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

#### Text Books:

1. Sterling, T., et al. (2018). High Performance Computing: Modern Systems and Practices. Morgan Kaufmann Publishers

#### Reference Books:

1. Dongarra, J., et al. (2011). High Performance Computing: From Grids and Clouds to Exascale. Elsevier Science.

2. Wilkinson, B., & Allen, M. (2019). *Parallel Programming: Concepts and Practice*. Morgan Kaufmann Publishers.
3. Gropp, W., et al. (2014). *Using MPI: Portable Parallel Programming with the Message-Passing Interface*. MIT Press

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2		1						1		
CO2	2										
CO3	1									1	
CO4				2							
CO5	2					1	1	1	1		

## Internet of Things

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Internet of Things
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	Core Course
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. To gain a comprehensive understanding of the IoT ecosystem.</li> <li>2. To learn about IoT protocols, standardization efforts, M2M and WSN, SCADA and RFID protocols.</li> <li>3. To comprehend IoT architecture, open-source architecture (OIC), design principles, IoT devices and deployment models.</li> <li>4. To understand the differences between Web of Things and Internet of Things.</li> <li>5. To explore IoT applications for the industry, future factory concepts.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Demonstrate an understanding of the importance of the IoT ecosystem.</p> <p>CO2. Analyze and compare IoT protocols, including M2M and WSN.</p> <p>CO3. Design and implement an IoT architecture, including the OIC architecture and design principles.</p> <p>CO4. Evaluate and compare Web of Things (WoT) and Internet of Things (IoT) architectures.</p> <p>CO5. Develop and implement IoT applications for industry, including future factory concepts.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>IOT</b> - What is the IoT and why is it important? Elements of an IoT ecosystem, Technolog, drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security, Issues.	CO1

<b>UNIT2</b>	<b>IOT PROTOCOLS</b> - Protocol Standardization for IoT – Efforts – M2M and WSN, Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security	CO2
<b>UNIT3</b>	<b>IOT ARCHITECTURE</b> - IoT Open source architecture (OIC)- OIC Architecture &, Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.	CO3
<b>UNIT4</b>	<b>WEB OF THINGS</b> - Web of Things versus Internet of Things – Two Pillars of the Web, – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.	CO4
<b>UNIT5</b>	<b>IOT APPLICATIONS</b> - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Honbo Zhou, (2012) “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press,
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), (2011) “Architecting the Internet of Things”, Springer.

**Reference Books:**

1. Vijay Madiseti and Arshdeep Bahga, (2014) “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT,

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2		1						1		
CO2	1	1	1					1			
CO3		2	1					1		2	
CO4		1		2				1			
CO5				1		1	1				1

## Mobile Computing

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Mobile Computing
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	Core Course
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. To understand the basic concepts of mobile computing.</li> <li>2. To learn the basics of mobile telecommunication system.</li> <li>3. To be familiar with the network layer protocols and Ad-Hoc networks.</li> <li>4. To know the basis of transport and application layer protocols.</li> <li>5. To gain knowledge about different mobile platforms and application development</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Explain the basics of mobile telecommunication systems</p> <p>CO2. Illustrate the generations of telecommunication systems in wireless networks</p> <p>CO3. Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network</p> <p>CO4. Explain the functionality of Transport and Application layers</p> <p>CO5. Develop a mobile application using android/blackberry/ios/Windows SDK / Explain the 5G network Architecture</p>

	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction:</b> Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA	CO1
<b>UNIT2</b>	<b>Mobile Telecommunication System:</b> Introduction to Cellular Systems - GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover - Security	CO2
<b>UNIT3</b>	<b>Mobile Network Layer:</b> Mobile IP – DHCP – adhoc- Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing-	CO3

	ODMRP, Vehicular Ad Hoc networks ( VANET) –MANET Vs VANET – Security	
<b>UNIT4</b>	<b>Mobile Transport And Application Layer:</b> Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WM	CO4
<b>UNIT5</b>	<b>Mobile Platforms And Applications:</b> Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: ios, Android, blackberry, Windows Phone – mcommerce – Structure – Pros & Cons – Mobile Payment System – Security Issue	CO5
<b>UNIT6</b>	Introduction to 5G: Introduction, features and challenges, Applications of 5G, 5G network architecture	

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Text Books:

1. Jochen Schiller, (2003) Mobile Communications, PHI, Second Edition,.
2. Prasant Kumar Pattnaik, Rajib Mall, (2012) Fundamentals of Mobile Computing, PHI Learning Pvt.Ltd, New Delhi .

### Reference Books:

1. Dharma Prakash Agarval, Qing and An Zeng, (2005) "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd,.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, (2003) Principles of Mobile Computing, Springer.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								2		
CO2	2		1								
CO3		1	1					1		1	
CO4	1										
CO5				2	1			1	1		

### Information Retrieval Systems

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29

<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Information Retrieval Systems
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. Learn to write code for text indexing and retrieval.</li> <li>2. Learn to evaluate information retrieval systems</li> <li>3. Learn to analyze textual and semi-structured data sets</li> <li>4. Learn to evaluate information retrieval systems</li> <li>5. Learn about text similarity measure</li> <li>6. Understanding about search engine</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <p>CO1. Explain information retrieval systems</p> <p>CO2. Apply IR principles to locate relevant information large collections of data</p> <p>CO3. Design different document clustering algorithms</p> <p>CO4. Implement retrieval systems for web search tasks</p> <p>CO5. Design an Information Retrieval System for web search tasks.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses  Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities	CO1
<b>UNIT2</b>	Cataloguing and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction  Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models	CO2
<b>UNIT3</b>	Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages  Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters	CO3
<b>UNIT4</b>	User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted	CO4

	Searches of Boolean Systems, Searching the INTERNET and Hypertext  Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies	
<b>UNIT5</b>	Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems  Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval	CO5

### Text book

1. Kowalski, G. J., & Maybury, M. T. (Year). Information Storage and Retrieval Systems – Theory and Implementation (2nd ed.). Springer.

### Reference Book

2. Frakes, W.B., Ricardo Baeza-Yates: (1992) Information Retrieval Data Structures and Algorithms, Prentice Hall.
3. Yates and Neto ,Modern Information Retrieval, Pearson Education

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								2		
CO2		1	1								
CO3		1									
CO4				1						1	
CO5						1					1

### Cyber Security and Privacy

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	Multidisciplinary Courses
<b>Semester</b>	NA
<b>Course Title</b>	Cyber Security and Privacy
<b>Course Code</b>	CSMDC - 101

<b>Credit</b>	L-T-P- 3-0-0 Total Credit - 3
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Understand the importance of cybersecurity and the impact of cyber-attacks on organizations and individuals.</li> <li>2. Recognize different types of cyber threats and attacks, such as malware, viruses, and ransomware, and understand how to mitigate them.</li> <li>3. Identify and evaluate various cybersecurity technologies and tools, including intrusion detection and prevention systems, security information and event management, endpoint protection tools, and vulnerability assessment and penetration testing.</li> <li>4. Develop information security policies and procedures, incident response planning and management, security awareness and training, and physical security considerations to ensure the security of organizational assets.</li> <li>5. Stay up-to-date with emerging cybersecurity threats and trends, advances in cybersecurity technologies, and ethical considerations in cybersecurity to ensure preparedness for the future.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO6. Understand the definition of Cybersecurity and the importance of protecting digital assets.</p> <p>CO7. Recognize various types of Cybersecurity threats and attacks, and apply risk management principles to assess and mitigate potential vulnerabilities.</p> <p>CO8. Explain basic Cryptography and encryption concepts, network security, firewalls, and identify security tools used in Cybersecurity.</p> <p>CO9. Develop Information Security policies and procedures, incident response planning, and management, and evaluate compliance with regulatory requirements.</p> <p>CO10. Analyze emerging Cybersecurity threats and trends, evaluate the latest Cybersecurity technologies, and understand ethical considerations in Cybersecurity.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction to Cybersecurity:</b> Definition of Cybersecurity ,Importance of Cybersecurity, Cybersecurity threats and attacks, Overview of Cybersecurity frameworks and standards ,Basic principles of Cybersecurity	CO1
<b>UNIT2</b>	<b>Network Security:</b> Fundamentals of network security, Types of network security threats, Network security protocols and technologies, Network security best practices	CO2
<b>UNIT3</b>	<b>Cybersecurity Technologies and Tools:</b> Intrusion detection and prevention systems (IDS/IPS), Security Information and Event Management (SIEM), Endpoint protection tools	CO3

	,Vulnerability assessment and penetration testing, Security Operations Center (SOC) tools	
<b>UNIT4</b>	<b>Cybersecurity Policies and Procedures:</b> Information security policies and procedures, Incident response planning and management, Security awareness and training, Physical security considerations, Compliance and regulatory requirements	CO4
<b>UNIT5</b>	<b>Future of Cybersecurity:</b> Emerging Cybersecurity threats and trends, Advances in Cybersecurity technologies, Ethical considerations in Cybersecurity	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Suggested Books:**

2. Ciampa, M. (2021). Security+ guide to network security fundamentals. Cengage Learning.

**Reference Books:**

2. Pfleeger, C. P., & Pfleeger, S. L. (2018). Security in computing. Pearson

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								2		
CO2		1	1							2	
CO3							1	1			
CO4				1	2			1			
CO5				2			1				2

**Parallel computing**

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Parallel computing
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4

<b>Course Type</b>	CC
<b>Course Objective</b>	The subject aims to provide the student with: <ol style="list-style-type: none"> <li>1. To introduce students to the concept of parallel computing.</li> <li>2. To equip students with knowledge of parallel algorithms and data structures, including sorting and searching algorithms in parallel.</li> <li>3. To provide students with an understanding of parallel programming languages and environments, including OpenMP, MPI, CUDA, parallel programming environment and tools.</li> <li>4. To expose students to various parallel computing applications.</li> <li>5. To help students understand the challenges in parallel computing, including scalability, load balancing, fault tolerance, and synchronization.</li> </ol>
<b>Course Outcome (COs)</b>	After completion of this course students will be able to: <p>CO1. Understand the fundamentals of parallel computing and parallel architectures and models</p> <p>CO2. Analyze and develop efficient parallel algorithms and data structures for solving complex problems.</p> <p>CO3. Gain proficiency in parallel programming languages and environments.</p> <p>CO4. Identify and evaluate various applications of parallel computing in scientific computing, big data analytics, machine learning.</p> <p>CO5. Explore the challenges and future directions of parallel computing.</p>

### Course Outline

<b>Unit</b>	<b>Description</b>	<b>CO Mapping</b>
<b>UNIT1</b>	<b>Introduction to Parallel Computing</b> Overview of parallel computing, History and evolution of parallel computing, Fundamentals of parallel computing, Parallel architectures and models, Parallel programming paradigms	CO1
<b>UNIT2</b>	<b>Parallel Algorithms and Data Structures</b> Sorting and searching algorithms in parallel, Matrix operations in parallel, parallel graph algorithms, Parallel data structures, Distributed computing and data parallelism	CO2
<b>UNIT3</b>	<b>Parallel Programming Languages and Environments</b> Introduction to parallel programming languages: Open MP, MPI, CUDA, Parallel programming environment and tools, Parallel debugging and performance analysis, Parallel programming on cloud and distributed systems, Parallel software engineering and design patterns	CO3
<b>UNIT4</b>	<b>Parallel Applications and Case Studies</b> Parallel computing applications in scientific computing, finance, data mining, and image processing, Parallel computing for big data analytics and machine learning, Case studies of successful parallel computing projects, Parallel computing for high-performance computing and simulation, Parallel computing for web applications and social media	CO4
<b>UNIT5</b>	<b>Parallel Computing Challenges and Future Directions</b>	CO5

	Challenges in parallel computing: scalability, load balancing, fault tolerance, and synchronization, Parallel computing for heterogeneous systems and accelerators, Emerging trends in parallel computing: quantum computing, neuromorphic computing, and edge computing, Parallel computing in the era of cloud computing and big data, Future directions of parallel computing research and development	
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**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Textbook:**

Quinn, M. J. (2018). Parallel Programming in C with MPI and OpenMP (2nd ed.). McGraw-Hill Education.

**Reference book:**

Padua, D. (2018). Parallel Programming: From Multicores and GPU's to Petascale. Morgan Kaufmann.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2					1					
CO2		1		2						1	
CO3			1	1							
CO4		1	1	2						2	
CO5				1							1

## Advanced Computer Network

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Advanced Computer Network
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Develop a comprehensive understanding of the fundamentals of data communication, including the OSI and TCP/IP models.</li> <li>2. Analyze advanced topics in data communication, including congestion mechanisms.</li> <li>3. Evaluate the benefits and drawbacks of Software Defined Networking (SDN).</li> <li>4. Examine the use cases and benefits of Network Function Virtualization (NFV) in networking, including NFV orchestration.</li> <li>5. Explore emerging topics in data communication, including next-generation Internet architectures, green communication networks, quantum networking, and blockchain in networking.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Students will be able to describe the importance of data communication and the OSI and TCP/IP models.</p> <p>CO2. Students will be able to analyze different routing algorithms, including BGP, RIP, and OSPF, and apply them to real-world scenarios.</p> <p>CO3. Students will be able to implement advanced networking concepts such as ARQ protocols, multimedia networking, and sliding window protocols, and evaluate the performance of various TCP/IP variants.</p> <p>CO4. Students will be able to compare and contrast traditional networks with Software Defined Networking (SDN), and design SDN controllers and switches using Open Flow Protocol.</p> <p>CO5. Students will be able to identify use cases for Network Function Virtualization (NFV) in networking, orchestrate NFV deployments, and implement NFV Service Function Chaining and network slicing.</p>

### Course Outline

Unit	Description	CO Mapping
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<b>UNIT1</b>	Introduction to Data Communication, Definition and importance of Data Communication, OSI and TCP/IP model, Internet Multicasting, NAT, VPN, Routing algorithms - BGP, RIP, OSPF, Differentiated and Integrated Services	CO1
<b>UNIT2</b>	Advanced Topics in Data Communication , Congestion Mechanism in Networking ,ARQ protocols, Multimedia Networking, Implementation of multi-threaded Web Server/Web Proxy with Caching/Filtering features , Sliding Window protocol implementation, Performance study of various TCP/IP variants	CO2
<b>UNIT3</b>	Software Defined Networking (SDN), Comparison between SDN and traditional networks, SDN controller, Switch design, SDN Controller-Switch Protocols, Open Flow Protocol, Control Overhead and Handoff algorithms, Network Function Virtualization (NFV) Architecture	CO3
<b>UNIT4</b>	NFV Use Cases and Orchestration, Use cases for NFV in Networking, NFV Orchestration, NFV for 5G Networking, NFV Service Function Chaining , Network Slicing in NFV	CO4
<b>UNIT5</b>	Emerging Topics in Data Communication, Next generation Internet architectures , Green Communication Networks , Data Center Networking , Quantum Networking , Blockchain in Networking	CO5

### Evaluation:

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

### Textbook:

1. Kurose, J. F., & Ross, K. W. (2021). Computer networking: a top-down approach. Pearson.
2. Li, X., Ma, Y., & Zomaya, A. Y. (Eds.). (2020). Next-generation internet architectures and protocols. Springer.

### Reference Book

1. Beijnum, I. V. (2017). BGP. O'Reilly Media, Inc.
2. Gong, K., & Liu, J. (2019). Blockchain in 5G: Opportunities and research challenges. IEEE Communications Magazine, 57(10), 138-143.

CO	CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2	1							2		
CO2				1			2				
CO3			1	1		1					

CO4			1				1		2	
CO5			1			1				1

### Distributed System

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Distributed System
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. Understand the fundamentals of distributed computing, including its history, characteristics, benefits, and architectures.</li> <li>2. Learn the different models and algorithms used in distributed computing, including message-passing and shared-memory models, and distributed consensus algorithms.</li> <li>3. Gain knowledge about the principles of designing and implementing distributed systems, including middleware, security, and performance.</li> <li>4. Develop skills in designing and developing distributed applications using service-oriented architecture, web services, and mobile computing.</li> <li>5. Explore emerging trends and future directions in distributed computing, including edge computing, blockchain, and quantum computing.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. Understand the fundamental concepts of distributed computing, including its history, architecture, and paradigms.</p> <p>CO2. Apply various distributed computing models and algorithms, such as message-passing and shared-memory models, to solve real-world problems.</p> <p>CO3. Design and implement distributed systems that are secure, scalable, and performant, using middleware and infrastructure technologies.</p> <p>CO4. Develop distributed applications using modern frameworks and technologies, such as service-oriented architecture, web services, and mobile computing.</p> <p>CO5. Evaluate and analyse emerging trends and future directions in distributed computing, including block chain, distributed artificial intelligence, and quantum computing,</p>

### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	Introduction to Distributed Computing, Introduction to distributed computing, Evolution and history of distributed computing, Characteristics and benefits of distributed computing, Distributed systems architecture and models, Distributed computing paradigms	CO1
<b>UNIT2</b>	Distributed Computing Models and Algorithms, Message-passing model and algorithms, Shared-memory model and algorithms, Distributed file systems and database systems, Distributed algorithms for resource allocation, load balancing and fault tolerance, Distributed consensus algorithms	CO2
<b>UNIT3</b>	Distributed System Design and Implementation, Distributed system design principles , Distributed computing infrastructure and middleware, Distributed system security and privacy, Distributed system performance and scalability, Cloud computing and distributed computing on the Internet	CO3
<b>UNIT4</b>	Distributed Application Development, Distributed application design and development frameworks, Service-oriented architecture (SOA) and web services, Distributed data processing and analytics, Distributed computing for big data and Internet of Things (IoT), Mobile computing and distributed mobile applications	CO4
<b>UNIT5</b>	Emerging Trends and Future Directions in Distributed Computing, Edge computing and fog computing, Blockchain and distributed ledger technologies, Distributed artificial intelligence and machine learning, Quantum computing and distributed computing	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Textbook:**

1. Tanenbaum, A. S., & Van Steen, M. (2017). Distributed systems: Principles and paradigms (3rd ed.). Pearson Education.
2. Kshemkalyani, A.D. and Singhal, M., 2011. Distributed computing: principles, algorithms, and systems. Cambridge University Press.

**Reference Book:**

1. Coulouris, G. F., Dollimore, J., & Kindberg, T. (2011). Distributed systems: Concepts and design (5th ed.). Pearson Education

CORRELATION WITH PROGRAM OUTCOMES	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES
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CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PSO 1	PSO 2	PSO 3
CO1	2								2		
CO2		1		2							
CO3								2		2	
CO4				1	2						
CO5			1					1			2

### Software Testing

<b>School</b>	Birla School of Applied Sciences
<b>Programme</b>	BCA
<b>Batch</b>	2025-29
<b>Branch/Discipline</b>	BCA
<b>Semester</b>	
<b>Course Title</b>	Software Testing
<b>Course Code</b>	
<b>Credit</b>	L-T-P- 3-1-0 Total Credit - 4
<b>Course Type</b>	CC
<b>Course Objective</b>	<p>The subject aims to provide the student with:</p> <ol style="list-style-type: none"> <li>1. To study fundamental concepts in software testing</li> <li>2. To discuss various software testing issues and solutions in software unit test, integration and system testing.</li> <li>3. To expose the advanced software testing topics, such as object-oriented software testing methods.</li> </ol>
<b>Course Outcome (COs)</b>	<p>After completion of this course students will be able to:</p> <p>CO1. List a range of different software testing techniques and strategies and be able to apply specific(automated) unit testing method to the projects.</p> <p>CO2. Distinguish characteristics of structural testing methods.</p> <p>CO3. Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.</p> <p>CO4. Discuss about the test case design methods.</p> <p>CO5. Demonstrate various QA and QC with test metrics</p>

### Course Outline

Unit	Description	CO Mapping
<b>UNIT1</b>	<b>Introduction:</b> Software Testing, Importance of testing, Roles and Responsibilities, Testing Principles, Attributes of Good Test, V-Model, Test Case Generation, SDLC Vs STLC, Software Testing	CO1

	Life Cycle-in detail. Testing Strategies: Unit Testing, Integration Testing, System Testing, Smoke, Regression Testing, Acceptance Testing. Clean Room Software Engineering.	
<b>UNIT2</b>	<b>Types of Testing:</b> Functional/Non-Functional Testing. Testing Tools, Categorization of testing methods: Manual Testing, Automation Testing, Non Functional Testing: Performance Test, Memory Test, Scalability Test, Compatibility Test, Security Test, Cookies Test, Session Test, Recovery Test, Installation Test, Ad-hoc Test, Risk Based Test, Compliance Test.	CO2
<b>UNIT3</b>	<b>Software Testing Methodologies and Software Testing Life Cycle:</b> Validation & Verification, White/Glass Box Testing, Black Box Testing, Grey Box Testing, Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing, Boundary Value Analysis, Equivalence Class Partition, State Based Testing, Cause Effective Graph, Decision Table, Use Case Testing, Exploratory testing and Testing Metrics, Testing GUI Requirements Analysis/Design, Traceability Matrix, Test Planning, Objective, Scope of Testing, Schedule, Approach, Roles & Responsibilities, Assumptions, Risks & Mitigations, Entry & Exit Criteria, Test Automation, Deliverables.	CO3
<b>UNIT4</b>	<b>Test Cases Design:</b> Write Test cases, Review Test cases, Test Cases Template, Types of Test Cases, Difference between Test Scenarios and Test Cases. Test Environment setup, Understand the SRS, Hardware and software requirements, Test Data. Test Execution: Execute test cases, Error/Defect Detecting and Reporting, DRE (Defect Removal Efficiency), Object, Types of Bugs, Art of Debugging, Debugging Approaches, Reporting the Bugs, Severity and priority, Test Closure, Criteria for test closure, Test summary report.	CO4
<b>UNIT5</b>	<b>Test Metrics and: QA &amp; QC &amp; Testing:</b> Test Measurements, Test Metrics, Metric Life Cycle, Types of Manual Test Metrics. Quality Assurance, What is Quality Control, Differences of QA, QC & Testing.	CO5

**Evaluation:**

Mode of Evaluation	Theory	
Weightage	Continuous Evaluation	End Semester Examination
	40	60

**Text Books:**

1. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill International Editions
2. Ian Sommerville, Software engineering, Pearson education Asia
3. Software Testing Techniques, 2nd edition, Boris Beizer, 1990
4. Software Testing: Principles and Practices by Srinivasan Desikan

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