BGU
BIRLA GLOBAL UNIVERSITY

# BACHELOR OF SCIENCE IN DATA SCIENCE

## B.Sc. (DS)

**2023 - 2027**

**(AS PER NEP 2020)**

## PROGRAMME STRUCTURE & SYLLABUS


Birla School of Applied Sciences
Birla Global University

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## PART-1

## ABOUT THE PROGRAMME

## Mission

The mission of BSC Data Science program is to provide students with a comprehensive education in data science and analytics through innovative and diverse curriculum, research, and industry collaborations. We strive to prepare our graduates to become ethical and responsible data professionals who can effectively communicate insights and drive positive change in the global society.

## Vision

Our vision is to become a globally recognized leader in data science education and research, promoting inclusiveness, excellence, and innovation. We aim to produce graduates who can tackle complex data challenges in diverse fields, embrace diversity and inclusiveness, and contribute to the advancement of knowledge and human development.

## Course Objective

1. To develop a strong foundation in mathematics, statistics, and computer science that enables students to work with large datasets, create models, and develop algorithms to extract insights from data.
2. To equip students with the skills and knowledge needed to work with data in a variety of contexts, including business, healthcare, social sciences, and more.
3. To provide students with practical experience using industry-standard tools and techniques for data collection, storage, analysis, and visualization.
4. To teach students how to communicate effectively with stakeholders from diverse backgrounds, including non-technical audiences, and to present data-driven insights in a clear and compelling manner.
5. To cultivate an ethical and socially responsible approach to data science, including issues related to data privacy, bias, and fairness.

## Name of the Programme

Bachelor of Computer Applications

## Description of the Programme

The Bachelor of Computer Applications (BSC(DS)) program is designed to provide students with a comprehensive understanding of the field of computer science and its applications in various industries. BSC(DS) 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.

BSC(DS) 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 BSC(DS) will be minimum 120 credits and that for 4-year BSC(DS) (Hons with Research) degree, the minimum credits will be160.
- 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 (BSC(DS)) Program**

**6.1 Discipline-Specific Courses (Core Major Courses):** The BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) program offers three skill enhancement courses to help students develop specific technical skills in areas such a programming frameworks, software tools, data analytics, or cybersecurity. Each SEC course involves nine hours of instruction.

**6.6** Common Value-Added Courses (VAC): The BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) Program:

The Bachelor of Computer Applications (BSC(DS)) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) 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 BSC(DS) Programme:

The total credits for 3-year BSC(DS) will be minimum 120. Following types of courses will be offered for a 3-Year BSC(DS) 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 BSC(DS) (Hons./ Hons. with Research) Programme

The 4-year BSC(DS) (Hons with Research) degree will be minimum 160. Following types of courses will be offered for a 4-Year BSC(DS)(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.

| Graduate Attributes | |
|---|---|
| 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

| Program Educational Objectives (PEOs): | |
|---|---|
| **PEO1.** | Graduates of BSC(DS) program will have strong foundation in computer science and will be able to apply the knowledge in the real-world problem-solving. |
| **PEO2.** | Graduates of BSC(DS) program will have the ability to communicate effectively, work in teams, and adapt to changes in technology and environment. |
| **PEO3.** | Graduates of BSC(DS) program will have a strong sense of ethics and social responsibility, and will be able to contribute positively to the society. |

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

## 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.

| Program Specific Outcomes (PSOs) | |
|---|---|
| **PSO1.** | Professionally skilled and trained in the field of computer science, they can solve complex, real-time problems, which help them grow personally and professionally**.** |
| **PSO2.** | Understanding modern computer technologies and their applications to solve complex and critical issues that benefit society and the environment. |
| **PSO3.** | 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

| MAPPING OF PEO WITH PO | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **PEO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** |
| **PEO1** | H | H | H | M | M | M | M | H |
| **PEO2** | H | H | L | M | M | L | M | H |
| **PEO3** | H | M | L | H | M | M | H | H |
| **PEO4** | H | M | L | L | M | H | L | H |
| **PEO5** | H | M | H | L | H | M | L | H |
| ***Level of correlation:*** *3-High, 2-Medium, 1-Low* | | | | | | | | |

## Category wise Credits

| Se No | Couse Name | Abbreviations | Total Number of Course | Credit | Total Credit | Total Number of Course | Credit | Total Credit |
|---|---|---|---|---|---|---|---|---|
| 1 | Discipline Specific Courses - Core Major (Core) Course | CC | 15 | 60 | **120** | 20 | 80 | **160** |
| 2 | Inter disciplinary Minor | IDC | 6 | 24 | | 8 | 32 | |
| 3 | Multidisciplinary Course | MDC | 3 | 9 | | 3 | 9 | |
| 4 | Ability Enhancement Course | AEC | 3 | 8 | | 3 | 8 | |
| 5 | Skill Enhancement Course | SEC | 3 | 9 | | 3 | 9 | |
| 6 | Common Value-added Courses | VAC | 2 | 6 | | 3 | 6 | |
| 7 | Project and Internship | | 2 | 4 | | 3 | 16 | |
| 8 | Department Electives | DSE | 3 | | | 4 | | |

## Level and Credit distribution

| BSC(DS)/BSc (DS) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Level** | **CC** | **IDC** | **MDC** | **AEC** | **SEC** | **VAC** | **Project/ Internship** | **Total Credit** | **Exit Option** |
| **100** | 8 | 8 | 6 | 6 | 6 | 6 | 0 | 40 | **44** |
| **200** | 16 | 16 | 3 | 2 | 3 | 0 | 0 | 40 | **84** |
| **300** | 36 | 0 | 0 | 0 | 0 | 0 | 4 | 40 | **120** |
| **Total** | **60** | **24** | **9** | **8** | **9** | **6** | **04** | **120** | **128** |
| **400** | 20 | 8 | 0 | 0 | 12 | 0 | 0 | 40 | - |
| **Total** | 80 | 32 | 9 | 8 | 21 | 6 | 0 | **160** | **160** |

**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.

# PART-II

## Syllabus Structure and Detailed Syllabus

## PROGRAMME STRUCTURE & CREDIT DISTRIBUTION

SEMESTER-WISE DISTRIBUTION OF COURSES AND CREDITS FOR 3 YEARS BCA

**1st year**

| Sl. No | semester | Major (Core) | Minor | Multidisciplinary | Ability Enhancement Course | Skill Enhancement Course | Value Added Course | SIP Dissertation | Total Credit |
|---|---|---|---|---|---|---|---|---|---|
| 1st year | 1st | Computer System Architecture (4 credit) | Mathematical Foundations (4 credit) | Principles of Management (3 credit) | English Communication Skills & **Lab** (3 credit) | Problem Solving using C **& Lab** (3 credit) | Health and Wellness (1 credit) Environmental Science (2 credit) | 20 | 20 |
| | 2nd | Data Structure using C **& Lab** (4 credit) | Probability and Statistics (4 credit) | Cyber Security (3 credit) | Technical Communication **& Lab** (3 credit) | Object Oriented Programming Using Java **& Lab** (3 credit) | Indian Knowledge System (IKS) (3 credit) | 20 | 20 |

## 2nd Year

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2nd year | 3rd | Introduction to Artificial Intelligence (4 credit) | Computer Network (4 credit)<br>Data Mining using Python **& Lab** (4 credit) | Finanacial Institution & Market (3 credit)<br>Visual Communication (2 credit) | Database Management Systems **& Lab** (3 credit) | | | 20 | 20 |
| | 4th | Operating Systems (4 credit)<br>Machine Learning & **Lab** (4 credit)<br>Cloud Computing (4 credit) | Web Technology **& Lab** (4 credit)<br>Optimization Techniques (4 credit) | | | | | 20 | 20 |

## 3rd Year

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3rd year | 5th | **1.** Data Visualization and Interpretation **& lab** (4 credit)<br>2. Software Engineering using UML (4 credit) | | | | | | 20 | 20 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **3.** DSE-I (4 credit)<br>4. DSE-II (4 credit)<br>5. Internship (2 credit)<br>6. Social Responsibility and Community Engagement (2 credit) | | | | | | | |
| | 6th | 1. Theory of Computation (4 credit)<br>2. Blockchain Technologies (4 credit)<br>3. "DSE-III (4 credit)<br>4. Seminar (2 credit)<br>5. Project (6 credit) | | | | | | 20 | 20 |
| | | 60 | 24 | 09 | 08 | 09 | 06 | 04 | 120 |

16.2 4TH YEAR BCA BCA(HONS.) WITH RESEARCH- SPECIALIZATION COURSES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4th Year | 7th | 1. Research Methodology<br>2. Advanced Machine Learning<br>3. DSE-IV<br>4. Cryptography and Network Security<br>(16 credit) | 1. Introduction to Big Data<br>(4 credit) | | | | | | CC-5<br>IDC-2 |
| | 8th | R Programming for Machine Learning*<br>(4 credit) | Infromation Retrieval Systems<br>(4 credit) | | | | | Research Project & Dissertation (12) | |
| | | 20 | 08 | | | | | 12 | 40 |

# First Year

# Semester -I

### Problem Solving using C

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Problem Solving using C |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | SEC |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of computer programming.<br>2. An introduction to the fundamentals of C language.<br>3. An understanding of problem-solving programs. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain the flowcharts and algorithms<br>CO2. Explain the working and implementation of Array.<br>CO3. Demonstrate the benefits and use of Functions and Pointers.<br>CO4. Explain the working File.<br>CO5. Explain Sorting and Searching Techniques. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Programming**<br>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 | CO1 |
| **UNIT2** | **Control Structure and Array**<br>Conditional Branching: if, if else and else if ladder and switch, Iteration and loops: Iterative statements, nested loops, break and continue statements. Arrays & Strings: One- | CO2 |

| | | |
|---|---|---|
| | dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: | |
| **UNIT3** | **Function & Pointer**<br>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.<br><br>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. | CO3 |
| **UNIT4** | **Structure & File**<br>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. | CO4 |
| **UNIT5** | **Searching and Sorting**<br>Introduction to searching and sorting, Linear search, Binary search, selection sort, Bubble sort. | 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 | STATEMENT | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Explain the flowcharts and algorithms | 3 | 2 | 1 | 1 | - | 2 | - | 1 | 2 | 2 | 1 |
| CO2 | Explain the working and implementation of Array. | 2 | 2 | - | - | - | - | - | - | 2 | 1 | - |
| CO3 | Demonstrate the benefits and use of Functions and Pointers. | 2 | 2 | - | - | - | - | - | - | 2 | 1 | - |
| CO4 | Explain the working File. | 1 | 1 | - | - | 1 | - | - | - | 2 | 1 | - |
| CO5 | Explain Sorting and Searching Techniques | 2 | 2 | - | - | - | - | - | 1 | 2 | 1 | - |

**English Commination skills**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | English Commination skills |
| **Course Code** | |
| **Credit** | L-T-P- 2-0-0 Total Credit - 2 |
| **Course Type** | AEC |
| **Course Objective** | 1. To expose the students with communicative English as a tool for making professional career.<br>2. To expose the students with various skills sets by sensitizing them to the dynamics of body language. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Acquire correct usage of communicative English through vocabulary building, grammar and pronunciation.<br>CO2. Improve good listening skills.<br>CO3. Learning the phonetic alphabet |

| | |
|---|---|
| | CO4. Strengthen ability to be creative in written communication.<br>CO5. Increase reading speed and comprehension |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT 1** | **Remedial Grammar**<br>Identifying and rectifying common errors: Subject-verb agreement, Parts of Speech, Word choice, Vocabulary Building | CO1 |
| **UNIT 2** | **Listening Skills**<br>Listening Skills: Importance and types of Listening; The sounds of English, The International | CO2 |
| **UNIT 3** | Phonetic Alphabet (IPA); Vowels, diphthongs, consonants, consonant clusters; phonemic<br>transcription; Syllable division and word stress; sentence rhythm and weak forms, contrastive<br>stress Intonation: falling, rising and falling-rising tunes | CO3 |
| **UNIT 4** | **Reading and Writing Skills**<br>Reading Comprehension, Types of Reading; Paragraph writing, Letter writing, Descriptive and Concise Writing. | CO4 |
| **UNIT 5** | **Speaking Skills**<br>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:**


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

| CO | STATEMENT | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Acquire correct usage of communicative English through vocabulary building, grammar and pronunciation. | - | - | - | - | - | 3 | - | - | - | - | 1 |
| CO2 | Improve good listening skills. | - | - | - | - | 1 | 2 | - | - | - | - | 1 |
| CO3 | Learning the phonetic alphabet | - | - | 1 | - | - | - | - | - | - | - | 1 |
| CO4 | Strengthen ability to be creative in written communication. | - | - | - | - | - | - | - | 1 | - | - | 1 |
| CO5 | Increase reading speed and comprehension | - | - | - | - | - | 1 | - | - | - | - | 1 |

## Computer System Architecture

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSC(DS) |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSC(DS) |
| **Semester** | |
| **Course Title** | Computer System Architecture |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the basic organization of a computer system and its functional units<br>2. Analyze different number systems such as binary, decimal, octal and hexa, and apply arithmetic algorithms. |

| | |
|---|---|
| | 3. Examine memory hierarchy, CPU memory interaction, cache memory, and related mapping,<br>4. Evaluate different parallel processing techniques<br>5. Analyze characteristics of multiprocessors, interconnection structures, interprocessor arbitration, interprocessor communication |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>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.<br>CO2. Students will be able to perform arithmetic operations using different number systems<br>CO3. Students will be able to explain the memory hierarchy and the interaction between CPU and memory<br>CO4. Students will be able to describe parallel processing and pipelining, including arithmetic pipelining, instruction pipeline.<br>CO5. Students will be able to evaluate the characteristics of multiprocessors, including interconnection structures, interprocessor arbitration, interprocessor communication, and synchronization |

**Course Outline**

| **Unit** | **Description** | **CO Mapping** |
|---|---|---|
| **UNIT1** | Basic Computer Organization: functional units of computer system, Instruction codes, Computer instructions, Instruction Cycles | CO1 |
| **UNIT2** | Computer Arithmetic: Number System (Binary, Decimal, Octal, Hexa)Addition & Subtraction, Multiplication Algorithms, Division Algorithms, Booth Algorithm | CO2 |
| **UNIT3** | Memory and system organization — Memory hierarchy CPU memory interaction – Organization of memory modules – Cache memory and related mapping | CO3 |
| **UNIT4** | Parallel processing, Pipelining, Arithmetic pipelining, Instruction pipeline, RISC pipeline, Vector processing, Memory interleaving, Array processor, multiprocessor. | CO4 |
| **UNIT5** | 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 | STATEMENT | 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 | Students will be able to understand the functional units of a computer system and describe the instruction codes and cycles involved in computer instructions. | 2 | 1 | | | | | | | 1 | | |
| CO2 | Students will be able to perform arithmetic operations using different number systems | | 1 | | | | | | | 1 | | |
| CO3 | Students will be able to explain the memory hierarchy and the interaction between CPU and memory | 2 | | | | | | | | 1 | | |
| CO4 | Students will be able to describe parallel processing and pipelining, including arithmetic pipelining, instruction pipeline. | 1 | | | 1 | | | | | 1 | | |
| CO5 | Students will be able to evaluate the characteristics of multiprocessors, including interconnection structures, interprocessor arbitration, interprocessor communication, and synchronization | | 1 | | | | | | | 1 | | |

## Mathematical Foundations

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Mathematical Foundations |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |

| | |
|---|---|
| **Course Type** | CC |
| **Course Objective** | 1. To make the students understand the basic concepts of some Mathematical topics related to different branch of Applied Sciences (e.g. Data & Computer Science).<br>2. To give insights about the applications of those Mathematical topics in different branch of Applied Sciences. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Describe and interpret the concept of set theory, functions, matrices, linear equations, differentiation and integration.<br>CO2. Apply the concept and techniques of matrices and system of linear equations in the different branch of applied sciences that requires such concepts.<br>CO3. Describe the differentiation and integration and its uses.<br>CO4. Interpret the applicability of Multivariable Calculus and its thermos to apply in real words<br>CO5. Develop an understanding on the concepts of Graph theory. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT 1** | **Set and Functions**<br>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 |
| **UNIT 2** | **Matrices**<br>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 |
| **UNIT 3** | **Differential and Integral Calculus**<br>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 |

| | | |
|---|---|---|
| **UNIT 4** | **Multivariable Calculus**<br>Functions of several variables, Limit, Continuity, Partia derivatives, Euler's theorem for homogeneous functions Composite function and the Chain rules, Jacobian, Tota derivatives, Maxima – Minima. | CO4 |
| **UNIT 5** | **Introduction to Graph Theory**<br>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 | STATEMENT | 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 | Describe and interpret the concept of set theory, functions, matrices, linear equations, differentiation and integration. | 1 | 2 | - | - | - | - | - | - | - | 2 | - |
| CO2 | Apply the concept and techniques of matrices and system of linear equations in the different branch of applied sciences that requires such concepts. | - | - | - | - | - | - | - | 1 | - | - | 1 |
| CO3 | Describe the differentiation and integration and its uses. | - | - | - | 1 | - | 1 | - | - | - | - | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | Interpret the applicability of Multivariable Calculus and its thermos to apply in real words | - | - | - | - | - | | 1 | 1 | - | - | - |
| CO5 | Develop an understanding on the concepts of Graph theory. | - | - | 1 | 1 | - | - | - | - | 1 | - | - |

## Principle of Management

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Principle of management |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To enable student, understand the evolution management studies<br>2. To help students to understand the roles challenges, and opportunities of an organization<br>3. To help students understand the fundamentals of management process: planning, organizing, leadership and control from an organizational viewpoint<br>4. This course will be an introduction to enable students to understand and develop managerial thinking. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Describe and communicate the management evolution and how it will affect future managers.<br>CO2. Conceptually explain the fundamental terminology and frameworks in the four functions of management: planning, organizing, leading and controlling;<br>CO3. Analyse organizational case situations in different functions of management.<br>CO4. Identify appropriate management techniques that are used in managing contemporary organizations.<br>CO5. Evaluate leadership styles to anticipate the consequences of each leadership style. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | 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 |
| **UNIT2** | Nature and Purpose - Formal and Informal Organization - Organization Chart - Structure and Process - Depart mentation by different Strategies - Line and Staff Authority - Benefits and Limitations - De-Centralization and Delegation of Authority - Introduction to Human Resource management. | CO2 |
| **UNIT3** | 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 |
| **UNIT4** | 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<br><br>Leadership: Concept, Definition, Leadership Styles, Leadership Theories Transactional and Transformational Leadership, Leadership development. | CO4 |
| **UNIT5** | 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 |

**Evaluation:**

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

**Text Books**


1. Robbins, S. P., & Coulter, M. . Fundamentals of Management: Essential Concepts and Applications (9th ed.). Pearson Education.
2. R. Sivarethinamohan and P. Aranganathan, (2005) Principles of Management, 1st 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 | STATEMENT | 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 | Describe and communicate the management evolution and how it will affect future managers. | - | - | - | - | 2 | 2 | 8 | - | - | - | 1 |
| CO2 | Conceptually explain the fundamental terminology and frameworks in the four functions of management: planning, organizing, leading and controlling; | | | | | 3 | | | 1 | | | 1 |
| CO3 | Analyse organizational case situations in different functions of management. | | | | 2 | | | | | | | 1 |
| CO4 | Identify appropriate management techniques that are used in managing | | 1 | 2 | | | | | | | | 1 |
| 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 | | | | 1 | 1 | 1 | 1 | 2 | | 1 | 3 |

Health and Wellness

# Environmental Science

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | DS |
| **Semester** | |
| **Course Title** | Environmental Science |
| **Course Code** | |
| **Credit** | L-T-P- 2-0-0 Total Credit - 2 |
| **Course Type** | AEC |
| **Course Objective** | The course aims to train learners to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy. |
| **Course Outcome (COs)** | At the end of this course the learner is expected to;<br>CO1. Demonstrate skills in organizing projects for environmental protection and sustainability.<br>CO2. Analyze various projects and initiatives with respect to ecosystem restoration.<br>CO3. Interpret significance of carbon footprints.<br>CO4. Describe the environmental issues and their possible repercussions on the plant in the next few decades.<br>CO5. Summarize the green strategies and policies adopted by various business entities to preserve the environment. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT 1** | **Introduction**<br>Environmental Studies: Meaning, Nature, Scope, Importance and Limitations; Ecosystems; Biodiversity and Natural Systems; Natural Cycles and flows–material and energy; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic Zones of India; Biodiversity patterns and global biodiversity hotspots. Salient Features: Wildlife (Protection) Act, 1972; Water (Prevention and control of pollution) Act, 1974; Forest (Conservation) Act, 1980; Air (Prevention and control of pollution) Act, 1981; Environmental Protection Act, 1986. | CO1 |
| **UNIT 2** | **Environmental Concerns**<br>Human Systems and Human impact on natural systems, Climate Change, Air Issues: Ozone Depletion, Smog, Water issues: Water quality/access, Pollution, Land Use Changes, Soil degradation, Waste: Quantity generated, Treatment, ex: landfills v. incinerators, E-waste. Threats to biodiversity: | CO2 |

| | | |
|---|---|---|
| | Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. | |
| **UNIT 3** | **Measurement and Reporting**<br>ISO Standard 14001: Environmental Management System; Life Cycle Assessment; Environmental Product Declaration; Carbon Foot printing and Ecological Handprints; Environmental Impact Analysis, Environmental Impact Assessment in India: procedure & practices**.** | CO3 |
| **UNIT 4** | **Green Business**<br>Concept and Evolution of Green Business; Drivers and Motivations; Model of Corporate Greening; Green Business Strategies; Planning and Policy Initiatives for Green Business; Capturing Green Consumers; Preparing for the future. Green Tax Incentives and Rebates (to Green Projects and Companies). Green Reporting. National Green Tribunal: Structure, composition and functions. | CO3, CO4 |
| **UNIT 5** | **Emerging Trends**<br>Environmental Accounting: Concept, Significance, and Types. Environmental Economics, KYOTO Protocol: Aim, Vision, and Functioning; Carbon Trading; Green HRM, Green Marketing, Green Finance. Environmental Ethics. Corporate Environmental Responsibility, Green Entrepreneurship. | CO4, CO5 |

**Evaluation:**

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

**Text Books:**


1. Basu, M., & Xavier, S. (2016). Fundamentals of Environmental Studies. Cambridge: Cambridge University Press.
2. Basu, R. N. (2000). Environment. University of Calcutta.


**Reference Materials:**


1. Enger. E., & Smith, B. (2010). Environmental Science: A Study of Interrelationships, Publisher: McGraw Hill Higher Education.
2. Kumar, S., & Kumar, B. S. (2016). Green Business Management. Hyderabad: Thakur Publishing Pvt. Ltd.


| CO | STATEMENT | 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 | Demonstrate skills in organizing projects for environmental protection and sustainability. | | | | | | | 3 | 2 | | | 1 |
| CO2 | Analyze various projects and initiatives with respect to ecosystem restoration. | | | | 2 | | | | | | | 1 |
| CO3 | Interpret significance of carbon footprints. | | | | 1 | | | | | | | 1 |
| CO4 | Describe the environmental issues and their possible repercussions on the plant in the next few decades. | | | | | | | 1 | | | | 1 |
| CO5 | Summarize the green strategies and policies adopted by various business entities to preserve the environment. | | | | | | | | 1 | | | 1 |

**Problem Solving using C Lab**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | DS |
| **Semester** | |
| **Course Title** | Problem Solving using C Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | SEC |
| **Course Objective** | 1. Introduce the essential skills for a logical thinking to problem solving<br>2. Introduce the essential skills in programming for problem solving using computer. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Use of environment, use the primitive data types and data structures of "C".<br>CO2. State and use of sequence control statements of "C'.<br>CO3. Write programs functions (both in-built as well as user defined)<br>CO4. Explain the usage of arrays, pointers, structure, and union in "C". |

| | |
|---|---|
| | CO5. Explain the commands of File Management in "C" and implement it in program. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **Lab-1** | Familiarity with IDE Programs on arithmetic expressions, data type limits, operators and precedence. | CO1 |
| **Lab-2** | Programs on Conditional Branching. | CO2 |
| **Lab-3** | Programs on Loops. | CO2 |
| **Lab-4** | Programs on single dimensional array.<br>Programs on two-dimensional array. | CO2 |
| **Lab-5** | Programs on String operations (with and without library functions)<br>. | CO2 |
| **Lab-6** | Programs on Functions (including searching and sorting).<br>Programs on Recursive Functions | CO3 |
| **Lab-7** | Programs on Pointers.<br>Programs on Dynamic Memory Allocation.<br>. | C04 |
| **Lab-8 -9** | Programs on Structure & Union.<br>Programs on File Handling | CO4, CO5 |
| **Lab-10-12** | Programs on Searching and Sorting | CO2, CO3 |

**Evaluation:**

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

**Text Books:**


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


**Reference Books:**


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


| | | | |
|---|---|---|---|
| | | CORRELATION WITH PROGRAM OUTCOMES | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES |

| CO | STATEMENT | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | Use of environment, use the primitive data types and data structures of "C". | 2 | | 1 | | | | | | 2 | | |
| CO2 | State and use of sequence control statements of "C'. | | 2 | | | | | | | 2 | 2 | |
| CO3 | Write programs functions (both in-built as well as user defined) | | 1 | | | | 1 | | | 3 | 2 | |
| CO4 | Understand the usage of arrays, pointers, structure, and union in "C". | 1 | 1 | | 1 | | | | | 3 | | |
| CO5 | Understand the commands of File Management in "C" and implement it in program. | 1 | 2 | | | | | | | | | 1 |

**Communication Skill Lab**

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|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | DS |
| **Semester** | |
| **Course Title** | Communication Skill Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | AEC |
| **Course Objective** | 1. To expose the students with communicative English as a tool for making professional career.<br>2. To expose the students with various skills sets by sensitizing them to the dynamics of body language. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Acquire correct usage of communicative English through vocabulary building, grammar and pronunciation.<br>CO2. Improve good listening skills.<br>CO3. Learning the phonetic alphabet<br>CO4. Strengthen ability to be creative in written communication.<br>CO5. Increase reading speed and comprehension |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **Lab-1-2** | Remedial Grammar<br>Identifying and rectifying common errors: Subject-verb agreement, Parts of Speech, Word choice, Vocabulary Building | CO1 |
| **Lab-3-6** | Listening Skills<br>Listening Skills: Importance and types of Listening; The sounds of English, The International<br>Phonetic Alphabet (IPA); Vowels, diphthongs, consonants, consonant clusters; phonemic<br>transcription; Syllable division and word stress; sentence rhythm and weak forms, contrastive<br>stress Intonation: falling, rising and falling-rising tunes | CO2, CO3 |
| **Lab-6-8** | Reading and Writing Skills<br>Reading Comprehension, Types of Reading; Paragraph writing, Letter writing, Descriptive and Concise Writing. | CO4 |
| **Lab- 9-12** | Speaking Skills<br>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 | STATEMENT | 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 | Acquire correct usage of communicative English through vocabulary building, grammar and pronunciation. | | | 1 | | | 3 | | | 1 | | 2 |
| CO2 | Improve good listening skills. | | | | | 3 | | | 1 | | | 2 |
| CO3 | Learning the phonetic alphabet | | | | | | 3 | | | | | |
| CO4 | Strengthen ability to be creative in written communication. | | | | | | 2 | | 1 | | 2 | |
| CO5 | Increase reading speed and comprehension | | | | | 1 | 1 | | | | | |

# Semester -II

### Data Structure Using C

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Data Structure Using C |
| **Course Code** | |
| **Credit** | L-T-P- 2-0-0 Total Credit - 2 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To provide the knowledge of basic data structures and their implementations.<br>2. To understand importance of data structures in context of writing efficient programs.<br>3. To develop skills to apply appropriate data structures in problem solving. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>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.<br>CO2. Demonstrate proficiency in implementing various operations on data structures including insertion, |

| | |
|---|---|
| | deletion, traversal, and search for efficient and effective data processing.<br>CO3. Analyze and compare the pros and cons of various tree representations such as adjacency matrix and adjacency list for solving real-world problems.<br>CO4. Apply different sorting algorithms such as bubble sort, selection sort, quicksort, and merge sort for efficient data organization and retrieval.<br>CO5. Design and implement basic graph algorithms such as Depth First Search and Breadth First Search for analyzing graphs |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Abstract Data Types**<br>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 number. Queue: linear & circular queue, Deque & Applications. Matrix – sparse and dense. Representation of sparse matrix, Transpose & addition of sparse matrices. | CO1 |
| **UNIT2** | **Linked list and its representation**<br>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 |
| **UNIT3** | **Tree**<br>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 |
| **UNIT4** | **Sorting and Searching**<br>Bubble sort, selection sort quick sort and merge sort. Linear and binary search, Fibonacci search. | CO4 |
| **UNIT5** | **Basic Graph Algorithm**<br>Graph representation – adjacency matrix and list – pros and cons. Graph traversals – Depth First Search and Breadth First Search. | CO5 |

**Evaluation:**

| Mode of Evaluation | Theory | |
|---|---|---|
| Weightage | 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 | STATEMENT | 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 | 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. | 2 | 2 | | | | | | | 1 | | |
| CO2 | Demonstrate proficiency in implementing various operations on data structures including insertion, deletion, traversal, and search for efficient and effective data processing. | | 1 | | | | | | | | 1 | |
| CO3 | Analyze and compare the pros and cons of various tree representations such as adjacency matrix and adjacency list for solving real-world problems. | | 1 | | | | | | | | 1 | |
| CO4 | Apply different sorting algorithms such as bubble sort, selection sort, quicksort, and merge sort for efficient | | 1 | | 1 | | | | | 1 | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | data organization and retrieval. | | | | | | | | | | | |
| 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 | 1 | | | | | 1 | | | | | |

## Object Oriented Programming using Java

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Object Oriented Programming using Java |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit – 3 |
| **Course Type** | SEC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Learn the syntax, semantics and idioms of the Java programming language.<br>2. Gain confidence in object-oriented programming principles through lots of practical exercises that provide useful exposure to the core Java class libraries. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the fundamentals of Java programming language and its environment, fundamental programming structures of Java<br>CO2. Learn Inheritance and its types, including the use of the super keyword, Method overriding,<br>CO3. Gain a comprehensive understanding of Java's Multi-Threading concepts, String Handling, Java I/O, Wrapper Classes,<br>CO4. Understanding the concept of wrapper classes, frame works and connecting concept of data base<br>CO5. Collection Framework, Database, Event Handling, AWT |

**Course Outline**

| **Unit** | **Description** | **CO Mapping** |
|---|---|---|

| | | |
|---|---|---|
| **UNIT1** | **Introduction to Java and Java programming Environment. Object Oriented Programming Concepts**<br>Encapsulation, Abstraction, Inheritance, Polymorphism<br><br>**Fundamental Programming Structure**<br>Data Types, variable, keywords, typecasting, Arrays, Operators and their precedence.<br><br>**Control Flow**<br>Java's Control Statements (if, switch, iteration, statement, while, do-while, for, Nested loop).<br>Concept of Objects and Classes, Using Existing Classes building your own classes, constructor overloading, static , final, this keyword. | CO1 |
| **UNIT2** | **Inheritance**: Introduction, types of inheritance. Use of super keyword. Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.<br><br>**Packages & Interfaces**: Packages, Access Protection, importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.<br>**Exception Handling:** Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception. | CO2 |
| **UNIT3** | **Multi-Threading**<br>Java Thread Life Cycle, Thread Priorities, Synchronization, creating a thread, Runnable interface, Creating Multiple threads, using isAlive () and join (), wait () & notify ().<br>**String Handling**<br>String constructors, String length, Character Extraction, String Comparison, Modifying a string.<br>**Java I/O**<br>Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization. | CO3 |
| **UNIT4** | **Wrapper Classes**<br>Wrapper classes and its methods.<br>**Collection Framework**<br>Introduction, interfaces, List, Set, Map etc, List interfaces and its classes.<br>**Introduction to Database**<br>Introduction to Data Base. Driver Types, Registering Driver, Creating Connection, Executing SQL query using Statement, Prepared Statement. Result Set methods. | CO4 |
| **UNIT5** | **Event Handing**<br>Event Delegation Model, Event Classes, Event Listener Interfaces, Adapter classes.<br>**AWT**<br>AWT Classes window fundamentals, component, container, panel, Window, Frame,<br>working with Graphics, Control Fundamentals, Layout managers, Handling Events by Extending AWT components | CO5 |

| | | |
|---|---|---|
| | **Swing**<br>Icons & Labels, Text fields, Buttons, Combo boxes, Tabbed panes, Scroll panes, Trees, Tables. | |

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 | STATEMENT | 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 | Understand the fundamentals of Java programming language and its environment, fundamental programming structures of Java | 2 | 1 | | | | | | | 2 | | |
| CO2 | Learn Inheritance and its types, including the use of the super keyword, Method overriding, | 1 | 1 | 1 | | | | | 1 | | 2 | |
| CO3 | Gain a comprehensive understanding of Java's Multi-Threading concepts, String Handling, Java I/O, Wrapper Classes, | 1 | 1 | 2 | | | | | | | 2 | |
| CO4 | Understanding the concept of wrapper classes, frame works and connecting concept of data base | 1 | | | | | 1 | | | | | 1 |
| CO5 | Collection Framework, Database, Event Handling, AWT | | | | 1 | | | | | | | |

## Technical Communications

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |

| | |
|---|---|
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Technical Communications |
| **Course Code** | |
| **Credit** | L-T-P- 2-0-0 Total Credit - 2 |
| **Course Type** | AEC |
| **Course Objective** | The course will enable the students<br>1. To develop effective communication skills to be able to speak & write clearly and impactful in the professional contexts.<br>2. To develop adequate knowledge on grammar, vocabulary, and other writing techniques to construct resume, emails and reports<br>3.To develop LSRW skills required for effective communication |
| **Course Outcome (COs)** | CO1. Understand the principles & process of communication<br>CO2. Plan, execute and revise messages<br>CO3. Write various types of messages that include resume/online resume & technical reports<br>CO4. Present their ideas orally with effective body language and visually appealing ways<br>CO5. Communicate strategically in GD & PI, |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Communication: Principles & Practice**<br>Fundamentals of Communication; What is Technical Communication; 7 C's of Communication; Barriers to Effective Communication; Ways to Overcome Barriers; Interpersonal Communication; Intercultural Sensitivity in a Diverse World; Communication in an Organization; Horizontal & Vertical | CO1 |
| **UNIT2** | **Planning, Drafting & Revising**<br>Planning Writing; Steps of Writing; Purpose; Readers & Information; Mind Mapping with Technology; Drafting, Redrafting & Proof reading | CO2 |
| **UNIT3** | **Writing Formal Messages**<br>Understanding different types of messages; Writing with Different Formats; Strategies to Write & Respond to Types of Messages; Writing an Email, Preparing & Planning for a Technical Report; Analysing & Organising Data; Preparing an Outline & Structuring; Writing an Abstract, Structuring the Main Body, Back Matter of a Technical Report; Style & Tone; Unity, Punctuation & Grammatical Errors | CO3 |

| | | |
|---|---|---|
| **UNIT4** | **Technical & Impactful Presentation**<br>Planning & Preparation; Presentation; Styles & Methods; Creating Visually Appealing Slides; Clarity of Substance; Overcoming Stage Fear; Audience Analysis & Retention of Audience Interest; Responding to Questions: Having the Final Word | CO4 |
| **UNIT5** | **GD & Interview Skills**<br>Why GD is Important; Communication Skills for Effective Functional Roles in GD; Initiating & Summarizing; Language Functions; How to Plan & Prepare for Interview; Communicating Strategically & Responding to FAQs during Interview; Behavioural & Stress Interview. | CO5 |

**Evaluation:**

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

**Reference Books:**


1. Mukherjee S. Hory (2016). Business Communication: Connecting Work. Sec. Ed. OUP, New Delhi

2. Kumar, Sanjay (2016). Communication Skills. Sec. Ed. OUP. New Delhi

3. Raman, M. & Sharma, S. (2016). Technical Communication – Principles and Practices. Oxford Univ. Press, New Delhi.

4. Mitra, B. (2012). Personality Development and Soft Skills by OUP, New Delhi.


| CO | \ STATEMENT | 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 | Understand the principles & process of communication | | | | | | 2 | | | | | 1 |
| CO2 | Plan, execute and revise messages | | 1 | | | 2 | | | | | | |
| CO3 | Write various types of messages that include resume/online resume & technical reports | | | | 1 | | 1 | | 1 | | | |
| CO4 | Present their ideas orally with effective body language and visually appealing ways | | | | | | 2 | | | | | 1 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | Communicate strategically in GD & PI | | | | | | | | 1 | | | 1 |

## Probability and Statistics

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Probability and Statistics |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | IDC |
| **Course Objective** | 1. To make students familiar with the concept of Probability and Statistics and display data by means of various tables, charts, and graphs.<br>2. To learn different probability distribution functions, sampling distribution, large sample estimation and hypothesis testing and apply them to solve real-life problem. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand and apply Probability & statistics problems into application part.<br>CO2. Acquire knowledge on different probability distribution functions and its application.<br>CO3. Learn and apply sampling distribution and large sample estimation into real-life problem.<br>CO4. Implement Large Sample Tests of Hypothesis methods in solving the various problems.<br>CO5. Learn efficient Probability & statistics procedures to solve real life problem |

**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 | CO2 |

| | | |
|---|---|---|
| | and Hypergeometric probability distribution, Continuous Probability distribution: Normal distribution. | |
| **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 | STATEMENT | 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 | Understand and apply Probability & statistics problems into application part. | | 2 | | 1 | | | | | 1 | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | Acquire knowledge on different probability distribution functions and its application. | | | | 1 | | | | | | | |
| CO3 | Learn and apply sampling distribution and large sample estimation into real-life problem. | | | | | | | 1 | 1 | | 1 | |
| CO4 | Implement Large Sample Tests of Hypothesis methods in solving the various problems. | | | | 1 | 1 | | | | | | |
| CO5 | Learn efficient Probability & statistics procedures to solve real life problem | | 1 | | | | | 1 | | | | 1 |

**Indian Knowledge System (IKS)**

**Cyber security**

**Data Structure using C Lab**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Data Structure using C Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | CC |
| **Course Objective** | 1. To develop skills to design and analyze simple linear and nonlinear data structures.<br>2. To strengthen the ability to the students to identify and apply the suitable data structure for the given real world problem.<br>3. To enables them to gain knowledge in practical applications of data structures. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Student understands design and analyze the time and space efficiency of the data structure.<br>CO2. Implement the Stack, Queue and their applications.<br>CO3. Implement various types of linked lists and their applications<br>CO4. Perform basic operations on BST<br>CO5. Implement different sorting and searching algorithms. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| 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 | STATEMENT | 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 | Student understands design and analyze the time and space efficiency of the data structure. | 1 | 1 | | | | | | | 1 | | |
| CO2 | Implement the Stack, Queue and their applications. | | | | 1 | | | | | | 1 | |
| CO3 | Implement various types of linked lists and their applications | 1 | | | | | | | | 1 | | |
| CO4 | Perform basic operations on BST | | | | 1 | | | | | | 1 | |
| CO5 | Implement different sorting and searching algorithms | | 1 | | | | | | | | 1 | |

## Java Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Java Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | SEC |
| **Course Objective** | 1. To teach the students basics of JAVA programs and its execution.<br>2. To teach the students the differences between C++ and Java programming.<br>3. To make the students learn concepts like packages and interfaces.<br>4. To make the students understand life cycle of the applets and its functionality.<br>5. To make the students understand the usage util package.<br>6. To teach the student, to develop java programs using interfaces. |
| **Course Outcome (COs)** | CO1. Able to use Java compiler and eclipse platform to write and execute java program.<br>CO2. Understand and Apply Object oriented features and Java concepts.<br>CO3. Able to apply the concept of multithreading and implement exception handling. |

| | |
|---|---|
| | CO4. Able to access data from a Database with java program.<br>CO5. understand the usage util package. |

**Course Outline**

| Lab | Description | CO Mapping |
|---|---|---|
| **Lab :1** | • Write a java program to print a string.<br>• Write a java program to multiply two given matrices. | **CO1** |
| **Lab :2** | • Write a java program to display the employee details using Scanner class.<br>• Write a java program that checks whether a given string is palindrome or not. | **CO2** |
| **Lab :3** | • Write a java program for Method overloading and Constructor overloading. | **CO3** |
| **Lab :4** | • Write a java program to represent Abstract class with example.<br>• Write a java program to implement Interface using extends keyword | **CO3** |
| **Lab :5** | • Write a java program to create user defined package. | **CO1** |
| **Lab :6** | • Write a java program to create inner classes.<br>• Write a java program for creating multiple catch blocks. | **CO1** |
| **Lab :7** | • Write a java program for producer and consumer problem using Threads. | **CO2** |
| **Lab :8** | • Write a Java program that implements a multi-thread application that has three threads. | **CO2** |
| **Lab :9** | • Write a java program to represent Array List class | **CO3** |
| **Lab :10** | • Write a java program for handling Mouse events and Key events. | **CO4** |
| **Lab :11** | • Write a java program that connects to a database using JDBC | **CO4** |
| **Lab :12** | • Write a java program to connect to database using | **CO5** |

**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 | STATEMENT | 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 | Able to use Java compiler and eclipse platform to write and execute java program. | 1 | | 1 | | | | | | 2 | | |
| CO2 | Understand and Apply Object oriented features and Java concepts. | 1 | 1 | | | | | | | | | |
| CO3 | Able to apply the concept of multithreading and implement exception handling. | 1 | | | | | | | | | 2 | |
| CO4 | Able to access data from a Database with java program. | | | | | | | | 1 | | | |
| CO5 | understand the usage package. | | | 1 | 1 | | | | | | | 1 |

| | | | |
|---|---|---|---|
| | Group Discussion and Debate Lab | 1 | AEC-2 |

# Second Year

# Semester -III

**Database Management Systems**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSC-DS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BCA |
| **Semester** | III |
| **Course Title** | Database Management Systems |
| **Course Code** | BSC-DS-302 |
| **Credit** | 2 |
| **Course Type** | SEC |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of DBMS.<br>2. An introduction to the Entity Relationship Models.<br>3. An understanding of Relational Algebra.<br>4. An induction to constraints, View and SQL.<br>5. An introduction to Transactions. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1: Explain the needs of DBMS.<br>CO2: Explain the working of ER models.<br>CO3: Demonstrate the use of Relational Algebra.<br>CO4: Explain the usage of constraints, View and SQL.<br>CO5:Demonstrate the concepts of Transactions and ACID property. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT 1** | **Introduction to Databases and Transactions and Data Models:**<br>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 |
| **UNIT 2** | **Database Design, ER-Diagram and Unified Modelling Language** | CO2 |

| | | |
|---|---|---|
| | 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). | |
| **UNIT 3** | **Relational Algebra and Calculus**<br>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 |
| **UNIT 4** | **Constraints, Views and SQL**<br>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. | C04 |
| **UNIT 5** | **Transaction management and Concurrency control**<br>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 |

**Evaluation:**

| **Mode of Evaluation** | 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

Visual Communication

**Data Mining using Python**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Data Mining Using Python |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | IDC |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of Data Mining<br>2. An understanding of different types of Data<br>3. An understanding of Pre-processing of Data<br>4. An understanding of mining frequent patterns and associations<br>5. An introduction to cluster analysis |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain the needs of Data Mining<br>CO2. Explain the requirement of Data Exploration and its uses.<br>CO3. Explain the process of Data Pre-processing<br>CO4. Explain the working of Association Rule Mining with its use cases.<br>CO5. A better understanding of clustering data |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction Data Mining**<br>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 | **CO1** |
| **UNIT2** | **Data Exploration**<br>Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data visualization, Data Similarity and Dissimilarity | **CO2** |
| **UNIT3** | **Data Pre processing**<br>**Data cleaning:** Noisy Data Removal, Duplicates Removal, Missing value handling, Outlier detection and removal<br>**Data transformation:** Data type conversion (categorical data to numerical data), Data Reduction (PCA, LDA)<br>**Data normalization:** min-max normalization and z-score normalization | **CO3** |
| **UNIT4** | **Mining Frequent Patterns, Associations, and Correlations**<br>Mining Frequent Patterns, Associations and Correlations, Mining Methods, Mining various Kinds of Association Rules, Correlation Analysis, Constraint Based Association Mining Classification and Prediction. | **CO4** |
| **UNIT5** | **Cluster Analysis**<br>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. | **CO5** |

**Evaluation:**

| **Mode of Evaluation** | 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

| CO | STATEMENT | 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 | Explain the needs of Data Mining | 2 | | | | | | | | 1 | | |
| CO2 | Explain the requirement of Data Exploration and its uses. | | 1 | 1 | | | | | | 1 | | |
| CO3 | Explain the process of Data Pre-processing | 2 | | | 1 | | | | | | 1 | |
| CO4 | Explain the working of Association Rule Mining with its use cases. | 2 | | | | | | | 1 | | | 1 |
| CO5 | A better understanding of clustering data | 2 | | | | | | | | 1 | | |

**Computer Network**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Computer Networks |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | IDC |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of computer networks.<br>2. An introduction to Data Link Layer.<br>3. An understanding of Network Layer.<br>4. An introduction to Transport Layer.<br>5. An introduction to Presentation and Application Layer. |

| Course Outcome (COs) | After completion of this course students will be able to:<br>CO1. Explain the needs of Computer Networks.<br>CO2. Explain the working and need of Data Link Layer.<br>CO3. Demonstrate the use of and working of Network Layer.<br>CO4. Explain the working of Transport Layer.<br>CO5. Explain the need and working of Presentation and Application Layer. |
|---|---|

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction:**<br>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 |
| **UNIT2** | **Data Link Layer:**<br>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 |
| **UNIT3** | **Network Layer:**<br>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 |
| **UNIT4** | **Transport Layer:**<br>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 |

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

**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 | STATEMENT | 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 | Explain the needs of Computer Networks. | 1 | | | | | | | | 1 | | |
| CO2 | Explain the working and need of Data Link Layer. | | 1 | 1 | | | | | | | 1 | |
| CO3 | Demonstrate the use of and working of Network Layer. | | 1 | 1 | | | | | | 1 | | |
| CO4 | Explain the working of Transport Layer. | | | | 1 | | | | | | 1 | |
| CO5 | Explain the need and working of Presentation and Application Layer. | 1 | | | 1 | | | | | 1 | | |

**Introductions to Artificial Intelligence**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Introduction to Artificial Intelligent |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Develop a comprehensive understanding of the fundamental concepts and applications of Artificial Intelligence.<br>2. Gain knowledge of the major techniques and technologies used in Machine Learning and their applications in various domains.<br>3. Develop an understanding of Natural Language Processing and its applications in fields such as chatbots, sentiment analysis, and language translation.<br>4. Explore the applications and techniques of Computer Vision in real-world scenarios and understand the ethical considerations related to its use.<br>5. Stay up-to-date with emerging trends and advancements in AI, and understand their implications for society and the workforce. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Students will be able to define Artificial Intelligence, describe its history and applications, and analyze ethical considerations related to AI.<br>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.<br>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.<br>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. |

| | |
|---|---|
| | 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. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Artificial Intelligence**: 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 |
| **UNIT2** | **Machine Learning**: 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 |
| **UNIT3** | **Natural Language Processing (NLP)**: Introduction to NLP, Basic techniques of NLP, Applications of NLP, NLP libraries and tools, Ethical considerations in NLP | CO3 |
| **UNIT4** | **Computer Vision**: Introduction to Computer Vision, Basic techniques of Computer Vision, Applications of Computer Vision, Computer Vision libraries and tools, Ethical considerations in Computer Vision | CO4 |
| **UNIT5** | **Emerging Trends in Artificial Intelligence**: 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 | STATEMENT | 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 | Students will be able to define Artificial Intelligence, describe its history and applications, and analyze ethical considerations related to AI. | 2 | 1 | 1 | | | | | | 2 | | |
| CO2 | Students will be able to understand the basics of Machine Learning, including the different types of algorithms, data preparation, and processing. | | 1 | | 2 | | | | | | | 2 |
| CO3 | Students will be able to identify the different techniques used in Natural Language Processing, understand the applications of NLP | | | | | | 1 | 1 | 1 | | 1 | |
| CO4 | Students will be able to identify the different techniques used in Computer Vision, understand the applications of Computer Vision | | 2 | | 1 | | | | | | | 1 |
| CO5 | Students will be able to identify emerging trends in Artificial Intelligence, including advanced AI technologies and techniques. | | | | | | | | 1 | | | |

**Financial institution & market**

## Data Mining using Python Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |

| | |
|---|---|
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Data Mining using Python Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | IDC |
| **Course Objective** | 1. Develop Python proficiency for data mining:<br>2. Apply data mining techniques<br>3. Evaluate and interpret mining results:<br>4. Develop critical thinking and problem-solving skills.<br>5. Collaborate effectively in a team |
| **Course Outcome (COs)** | CO1. Develop proficiency in Python for data mining: Students will gain a strong foundation in Python and<br>CO2. Apply data mining techniques to real-world problems: Students will learn how to identify and apply appropriate data mining techniques<br>CO3. Evaluate and interpret mining results: Students will develop the ability to evaluate and interpret the results of data mining algorithms.<br>CO4. Develop critical thinking and problem-solving skills: Through the process of designing and implementing data mining solutions<br>CO5. Collaborate effectively in a team: Students will have opportunities to work collaboratively in small groups on data mining projects |

**Course Outline**

| Lab | Description | CO Mapping |
|---|---|---|
| **Lab :1** | Introduction to Python<br>• Introduction to Python and its data mining libraries (e.g., NumPy, Pandas, Scikit-learn) | **CO1** |
| **Lab :2** | • Matrix Operations | **CO1** |
| **Lab :3** | • Linear Algebra on Matrices | **CO2** |
| **Lab :4** | • Understanding Data | **CO2** |
| **Lab :5** | • Correlation Matrix | **CO2** |
| **Lab :6** | • Data Cleaning and Outlier Detection and handling missing values | **CO3** |

| | | |
|---|---|---|
| **Lab :7** | Data Transformation and Normalization<br>• Data transformation techniques (e.g., data type conversion, data reduction)<br>• Techniques for data normalization (e.g., min-max normalization, z-score normalization)<br>• Implementation of data transformation and normalization using Python | **CO3** |
| **Lab :8** | Mining Frequent Patterns and Associations<br>• Frequent pattern mining and association rule mining<br>• Mining frequent patterns and associations using Python<br>• Evaluation and interpretation of mined patterns and associations | **CO4** |
| **Lab :9** | Correlation Analysis and Constraint-Based Mining<br>• Correlation analysis and constraint-based mining<br>• Techniques for mining correlation rules and constrained patterns<br>• Implementation of correlation analysis and constraint-based mining using Python | **CO4** |
| **Lab :10** | Classification and Prediction<br>• Classification and prediction techniques<br>• Techniques for feature selection and model evaluation<br>• Implementation of classification and prediction using Python | **CO5** |
| **Lab :11 -12** | Cluster Analysis<br>• Cluster analysis and its applications<br>• Techniques for clustering data (e.g., K-means, hierarchical clustering, density-based clustering)<br>• Implementation of cluster analysis using Python | **CO5** |

**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 (3rd ed.). Morgan Kaufmann Publishers.

**Reference books:**

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

with data.

| CO | STATEMENT | 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 | Develop proficiency in Python for data mining: Students will gain a strong foundation in Python and its data mining libraries | 2 | | | | | | | | 1 | | |
| CO2 | problems: Students will learn how to identify and apply appropriate data mining techniques for solving real-world problems. | | 1 | 1 | | | | | | 1 | | |
| CO3 | Evaluate and interpret mining results: Students will develop the ability to evaluate and interpret the results of data mining algorithms. | 2 | | | 1 | | | | | | 1 | |
| CO4 | Develop critical thinking and problem-solving skills: Through the process of designing and implementing data mining solutions, students will develop critical thinking | 2 | | | | | | | 1 | | | 1 |
| CO5 | Collaborate effectively in a team: Students will have opportunities to work collaboratively in small groups on data mining projects | 2 | | | | | | | | 1 | | |

**Database Management Systems Lab**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Database Systems Lab |
| **Course Code** | |

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

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| Lab 1-2 | • Introduction to basic DDL, DML and DCL commands and domain types in SQL.<br>• DDL statements to create, drop, alter, view and rename the Database. | **CO1, CO2, CO5** |
| Lab 3 | • 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.<br>• Write statements to add and delete a column in a table which is pre-existent.<br>• Write DML statements to update a table for single and multiple field updation.<br>• Write DML statements to delete single or multiple record(s) from a table. | **CO1, CO2, CO5** |
| Lab 4-5 | • Practice SELECT query with following options:<br>Distinct, order by, between, top/max/min and other aggregation keywords, group by, having, wild card matching, exists<br>• Nested subqueries | **CO3, CO4, CO5** |
| Lab 6 | • Practice SELECT query with following options: | **CO4, CO5** |

| | | |
|---|---|---|
| | Distinct, order by, between, top/max/min and other aggregation keywords, group by, having, wild card matching, exists<br>• Nested subqueries | |
| Lab 7 | • Write a query to create INNER JOIN / LEFT JOIN / RIGHT JOIN / FULL JOIN in two tables. | **CO4, CO5** |
| Lab 8 | • Add primary key constraint to a pre-existent table.<br>• Add NOT NULL / UNIQUE constraint to a pre-existent column.<br>• Define the foreign key constraint. Show the errors returned by Database when:<br>• a) FK constraint is violated<br>• b) A referenced item is deleted<br>• Define and demonstrate cascading effect in foreign key referenced tables.<br>• Define, add and drop the check/default constraint.<br>• Define auto increment arguments/attributes of a table. | **CO2, CO4, CO5** |
| Lab 9 | • Write a query to create/delete VIEW from two tables including some selection criteria.<br>• Write a query to create and delete clustered/non-clustered index for a table. | **CO5** |
| Lab 10-11 | • To implement the concept of trigger in database:<br>▪ How to apply database triggers<br>▪ Types of database triggers<br>▪ Create/delete database triggers<br>▪ Create trigger to demonstrate magic tables (INSERTED and DELETED).<br>▪ Create a hypothetical situation to undo the changes in a table via Trigger (Max credit limit reached/ Balance insufficient etc.). | **CO5** |
| Lab 12-13 | • Write some stored procedures to cover the following problems:<br>▪ Demonstrate Control structures<br>▪ Swap two numbers<br>▪ Find the sum of digits<br>▪ Calculate grades etc.<br>• Define Transaction, demonstrate the Commit and Rollback operations using hypothetical situations. | **CO4, CO5** |

**Evaluation:**

| | |
|---|---|
| Mode of Evaluation | Practical |

| Weightage | Continuous Evaluation | End Semester Examination |
|---|---|---|
| | 60 | 40 |

| CO | STATEMENT | 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 | Acquire a good understanding of database systems concepts. | 2 | | | | | | | | 1 | | |
| CO2 | Create and maintain tables using PL/SQL. | | \1 | | | | | | | | 1 | |
| CO3 | Application development using PL/SQL & front end tools | | | 1 | 1 | | | | | | | |
| CO4 | Understand the use of structured query language and its syntax. | 2 | | | | | | | | 1 | | 1 |
| CO5 | Demonstrate an understanding of the relational data model. | | 1 | 1 | | | | | | | | |

# Semester -IV

### Operating Systems

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Operating System |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |

| | |
|---|---|
| **Course Objective** | 1. To educate students regarding basics of operating system.<br>2. To sensitize students about organization and process scheduling.<br>3. To equip students with concurrency.<br>4. To train students about memory management.<br>5. To inculcate the benefits of File systems and storage management. |
| **Course Outcome (COs)** | **After completion of this course students will be able to:**<br>CO1. Understand the basic concepts of operating system.<br>CO2. Apply the organization and process scheduling.<br>CO3. Analyse the process synchronization.<br>CO4. An understanding of memory management.<br>CO5. Develop understanding of File systems and storage management. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT 1** | **Introduction**<br>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. | CO1 |
| **UNIT 2** | **Organization and Process Scheduling**<br>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. | CO2 |
| **UNIT 3** | **Process Synchronization**<br>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, Dinning Philosopher Problem etc., Multiprocessors and Locking - Scalable Locks - Lock-free coordination. | CO3 |
| **UNIT 4** | **Memory Management**<br>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 |

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|---|---|---|
| **UNIT 5** | **File Systems, storage management and security**<br>Concept of a file, Directory Structure, File Operations, File System Mounting, File Sharing, Protection, File System Structure, File System Implementation,<br>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 | |
|---|---|---|
| Weightage | Continuous Evaluation | End Semester Examination |
| | 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.

| **CO** | **STATEMENT** | 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 | Understand the basic concepts of operating system. | 2 | | 1 | | | | | | 1 | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | Apply the organization and process scheduling. | 1 | 2 | | | | | | | | | |
| CO3 | Analyse the process synchronization. | 1 | 2 | | 1 | | | | | | 1 | |
| CO4 | An understanding of memory management. | 1 | | | | | | | | | | |
| CO5 | Develop understanding of File systems and storage management. | | 1 | | 1 | | | | | 1 | | |

**Web Technology**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Web Technologies |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | IDC |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of competency in planning a website.<br>2. An ability to incorporate social media aspects, web–design principles like text and navigation<br>3. An understanding of Hosting / launching a website |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understanding the web design concept, planning and development.<br>CO2. Understand the website goals, business requirements and project plan<br>CO3. Understand the platform selection and content management<br>CO4. Understand the concept of web analytics<br>CO5. Understanding the concept of visitor count, website visibility and best practices. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Web Application:** 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 |
| **UNIT2** | **Getting Started in Web Design:** 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 |
| **UNIT3** | **Platform Selection, Content Management:** Introduction to HTML, DHTML, JavaScript, jQuery, and Ajax, Working with CSS, Introduction to Content management system, connecting a website to a CMS, Optimising your website, extending website functionality, fundamentals e-commerce websites. | CO3 |
| **UNIT4** | **Web Analytics:** Getting started with web analytics and handling web data, selecting the right web analytics tools, Reviewing Site Referrers. | CO4 |
| **UNIT5** | 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.

| | | CORRELATION WITH PROGRAM OUTCOMES | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES |
|---|---|---|---|

| CO | STATEMENT | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | Understanding the web design concept, planning and development. | 1 | 1 | 1 | | | | | | 1 | | |
| CO2 | Understand the website goals, business requirements and project plan | | | | | | | | 1 | | | |
| CO3 | Understand the platform selection and content management | 1 | | | | | | | | 1 | | |
| CO4 | Understand the concept of web analytics | | | 1 | | | | | | | | |
| CO5 | Understanding the concept of visitor count, website visibility and best practices. | | | | | | | | 1 | 1 | | |

**Machine Learning**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Machine Learning |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of Machine Learning.<br>2. An introduction to the fundamentals of Supervised Learning.<br>3. An understanding of Support Vector Machine.<br>4. An introduction to Evaluation.<br>5. An introduction to Unsupervised Learning.<br>6. An introduction to Deep Networks. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain Machine Learning as well as its needs.<br>CO2. Explain Supervised Learning and its usage.<br>CO3. Demonstrate the use of Support Vector Machine |

| | |
|---|---|
| | CO4. Understanding the concept of Deep Neural Networks and Convolution Neural Network<br>CO5. Understanding the concept and implementation of Genetic Algorithms |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction**:<br>Learning theory, Hypothesis and target class, Inductive bias and bias-variance tradeoff, Occam's razor, Approximation and estimation errors.<br>Dimensionality reduction and Feature selection, PCA,<br>**Model Evaluation:**<br>Performance evaluation metrics, ROC Curves, Validation methods | CO1 |
| **UNIT2** | **Supervised Learning:**<br>Linear separability and decision regions, Linear discriminants, Bayesian's Theory, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression,<br>**k-nearest Neighbour Algorithm**<br>**Artificial Neural Networks:** Introduction Mc-Culloh Pitts Neuron/ Perceptron Model, Multilayer Perception, Important terminologies of ANNs, Back Propagation | CO2 |
| **UNIT3** | **Support Vector Machines:** Structural and empirical risk, Margin of a classifier, Support Vector Machines, learning nonlinear hypothesis using kernel functions.<br>**Decision Tree:** Decision Tree Induction, Overfitting, Pruning of decision trees<br>Ensemble approach: Bagging and Boosting | CO3 |
| **UNIT4** | **Introduction to Deep Networks:**<br>Introduction to deep feed forward networks, convolutional neural networks, different terminologies related to CNN: stride, pooling, dropout, optimization techniques | CO4 |
| **UNIT5** | **Genetic Algorithms**: Genetic Algorithms: Motivation, Genetic Algorithms: Representing Hypotheses, Genetic Operator, Fitness Function and Selection, An Illustrative Example, Hypothesis Space Search, Genetic Programming.<br>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 | STATEMENT | 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 | Explain Machine Learning as well as its needs. | 2 | | 1 | | | 1 | | | 1 | | |
| CO2 | Explain Supervised Learning and its usage. | | 1 | | 1 | | | | | | | |
| CO3 | Demonstrate the use of Support Vector Machine | | | 1 | 1 | | | | 1 | | 1 | |
| CO4 | Understanding the concept of Deep Neural Networks and Convolution Neural Network | | 2 | | 2 | | 1 | | | 1 | | 1 |
| CO5 | Understanding the concept and implementation of Genetic Algorithms | 1 | | | | | | 1 | | | | |

| CO | STATEMENT | 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 | Understanding the basic concepts of time and space complexity | 2 | | | 1 | | | | | 1 | | |
| CO2 | Understand the basic concepts of algorithms. | | 2 | | | | | | | | | |
| CO3 | Understand and apply of different algorithmic approaches | | | 1 | | | | | | 1 | | |
| CO4 | Analyse the skills of Graphs, Trees algorithms. | 1 | | | | 1 | | | | | 1 | |
| CO5 | An understanding of selected topics like hard problems. | | 1 | | | | | | | | | |

**Optimization Techniques**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Optimization Techniques |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | 1. To make students understand the basics of optimization.<br>2. An introduction to single variable optimization.<br>3. An introduction to multivariable optimization.<br>4. An induction to constrained optimization algorithm.<br>5. An understanding of modern optimization algorithm. |

| | |
|---|---|
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Students understand the basic concept of optimizations problems and techniques<br>CO2. Explore various single variable optimization.<br>CO3. Sound knowledge of multivariable optimization.<br>CO4. Skills to understand constrained optimization algorithms.<br>CO5. Perform modern optimization algorithms. |

## Course Outline

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction and Basic Concepts**<br>Introduction to optimization problem, optimization problem formulation, examples of optimization problems, Local and global optimization, optimization algorithms | CO1 |
| **UNIT2** | **Single Variable Optimization**<br>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 |
| **UNIT3** | **Multivariable Optimization**<br>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 |
| **UNIT4** | **Constrained Optimization Algorithms**<br>Kuhn-Tucker conditions, transformation methods, sensitivity, direct search for constrained optimization, integer programming, Geometric programming. | CO4 |
| **UNIT5** | **Modern Optimization Techniques**<br>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 | STATEMENT | 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 | Students understand the basic concept of optimizations problems and techniques | 1 | | | 2 | | | | | | 1 | |
| CO2 | Explore various single variable optimization. | | 1 | | | | | | | 1 | | |
| CO3 | Sound knowledge of multivariable optimization. | 1 | | | | | | | | | | 1 |
| CO4 | Skills to understand constrained optimization algorithms. | | | 1 | | | | | | 1 | | |
| CO5 | Perform modern optimization algorithms | | | | 2 | 1 | | | | | 1 | |

**Cloud Computing**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Cloud Computing |

| | |
|---|---|
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with: |
| **Course Outcome (COs)** | 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.<br>CO2. Describe virtualization technology at compute, storage, network, desktop, and application layers of IT infrastructure.<br>CO3. Implement the key characteristics, services, and deployment models of cloud.<br>CO4. Elaborated the cloud infrastructure components and service management processes. Illustrate the cloud security concerns and solutions.<br>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. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | 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 |
| **UNIT2** | 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, Converting Physical Machines to Virtual Machines, Desktop and Application | CO2 |
| **UNIT3** | 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 | CO3 |

| | | |
|---|---|---|
| | Technologies, Network traffic management techniques in VDC Service. | |
| **UNIT4** | 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 |
| **UNIT5** | 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<br>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 | STATEMENT | 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 | Analyses the phases of transition from classic data center to virtual data center and then to the cloud. | 2 | | 1 | | | | | | | | 1 |
| CO2 | Describe virtualization technology at compute, storage, network, desktop, | | 1 | | | | | | | | 1 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | and application layers of IT infrastructure. | | | | | | | | | | | |
| CO3 | Implement the key characteristics, services, and deployment models of cloud. | | | 1 | | | | | 1 | | | |
| CO4 | Elaborated the cloud infrastructure components and service management processes. Illustrate the cloud security concerns and solutions. | | | | 1 | | | 2 | 1 | 2 | | |

## Web Technology Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Web Technology Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | IDC |
| **Course Objective** | 1. To introduce students to HTML and its various elements and their usage.<br>2. To enable students to create static web pages using HTML and frames.<br>3. To teach students the basics of cascading style sheets and their implementation in web pages.<br>4. To familiarize students with JavaScript and its usage for validating forms.<br>5. To introduce students to XML and its usage for data representation and exchange. |
| **Course Outcome (COs)** | CO1. Understand the concept of HTML and its various elements to create lists in a webpage.<br>CO2. Demonstrate the ability to create hyperlinks and navigate between pages or sections of a webpage.<br>CO3. Demonstrate the ability to create a timetable using tables and apply appropriate styling.<br>CO4. Understand the concept of frames and create a static home page using frames.<br>CO5. Demonstrate the ability to create a static registration form and validate it using JavaScript. |

**Course Outline**

| Lab | Description | CO Mapping |
|---|---|---|
| **Lab :1** | Write a HTML program for the demonstration of Lists. Unordered List , Ordered List, Definition List, Nested List | **CO1** |
| **Lab :2** | Write a HTML program for demonstrating Hyperlinks.<br>• Navigation from one page to another.<br>• Navigation within the page | **CO2** |
| **Lab :3** | Write a HTML program for time-table using tables. | **CO3** |
| **Lab :4** | • Write a HTML program to develop a static Home Page using frames.<br>• Write a HTML program to develop a static Registration Form.<br>• Write a HTML program to develop a static Login Page | **CO4** |
| **Lab :5** | • Write a HTML program to develop a static Web Page for Catalog.<br>• Write a HTML program to develop a static Web Page for Shopping Cart. | **CO5** |
| **Lab :6** | • Write HTML for demonstration of cascading stylesheets.<br>• Embedded stylesheets.<br>• External stylesheets.<br>• Inline styles. | **CO1, CO2** |
| **Lab :7** | Write a javascript program to validate USER LOGIN page. | **CO1, CO3** |
| **Lab :8** | Write a javascript program for validating REGISTRATION FORM | **CO1, CO4** |
| **Lab :9** | • Write a program for implementing XML document for CUSTOMER DETAILS.<br>• Write an internal Document Type Definition to validate XML for CUSTOMER DETAILS? | **CO2, CO4** |
| **Lab :10** | Write a JSP that reads parameters from user login page. | **CO2, CO3** |
| **Lab :11** | Write a JSP that reads a value, creates a cookie and retrieves it. | **CO2, CO3** |
| **Lab :12** | Write a servlet that connects to the database and retrieves the data and displays it. | **CO3, CO4** |

**Evaluation:**

| Mode of Evaluation | Laboratory |
|---|---|

| Weightage | Continuous Evaluation | End Semester Examination |
|---|---|---|
| | 60 | 40 |

**Reference Materials:**


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


| CO | STATEMENT | 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 | Understand the concept of HTML and its various elements to create lists in a webpage. | 1 | 1 | 1 | | | | | | 1 | | |
| CO2 | Demonstrate the ability to create hyperlinks and navigate between pages or sections of a webpage. | | | | | | | | 1 | | | |
| CO3 | Demonstrate the ability to create a timetable using tables and apply appropriate styling. | 1 | | | | | | | | 1 | | |
| CO4 | Understand the concept of frames and create a static home page using frames. | | | 1 | | | | | | | | |
| CO5 | Demonstrate the ability to create a static registration form and validate it using JavaScript. | | | | | | | | 1 | 1 | | |

## Machine Learning Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Machine Learning Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | CC |

| | |
|---|---|
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of Machine Learning.<br>2. An introduction to the fundamentals of Supervised Learning.<br>3. An understanding of Support Vector Machine.<br>4. An introduction to Evaluation.<br>5. An introduction to Unsupervised Learning.<br>6. An introduction to Deep Networks. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the import and export of data using python.<br>CO2. Demonstrate the various data pre-processing and dimension reduction methods<br>CO3. Demonstrate the linear regression model and implement the different classification techniques<br>CO4. Understanding the concept of Deep Neural Networks and Convolution Neural Network<br>CO5. Understanding the concept and implementation of Genetic Algorithms |
| | |

**Course Outline**

| **Lab** | **Description** | **CO Mapping** |
|---|---|---|
| **Lab :1** | Write a python program to import and export data using Pandas library functions | **CO1** |
| **Lab :2** | Demonstrate various data pre-processing techniques for a given dataset | **CO2** |
| **Lab :3** | Implement Dimensionality reduction using Principle Component Analysis (PCA) method. | **CO2** |
| **Lab :4** | Write a Python program to demonstrate various Data Visualization Techniques. | **CO3** |
| **Lab :5** | Implement Simple and Multiple Linear Regression Models. | **CO3** |
| **Lab :6** | Develop Logistic Regression Model for a given dataset. | **CO3** |
| **Lab :7** | Develop Decision Tree Classification model for a given dataset and use it to classify a new sample. | **CO4** |
| **Lab :8** | Implement Naïve Bayes Classification in Python | **CO5** |
| **Lab :9** | Build KNN Classification model for a given dataset. | **CO4** |
| **Lab :10** | Build Artificial Neural Network model with back propagation on a given dataset. | **CO4** |
| **Lab :11** | Build CNN Model on given data set | **CO4** |
| **Lab :12** | Implementation of Genetic Algorithm | **CO5** |

**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** | | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **STATEMENT** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Understand the import and export of data using python. | 2 | | 1 | | | 1 | | | 1 | | |
| CO2 | Demonstrate the various data pre-processing and dimension reduction methods | | 1 | | 1 | | | | | | | |
| CO3 | Demonstrate the linear regression model and implement the different classification techniques | | | 1 | 1 | | | | 1 | | 1 | |
| CO4 | Understanding the concept of Deep Neural Networks and Convolution Neural Network | | 2 | | 2 | | 1 | | | 1 | | 1 |
| CO5 | Understanding the concept and implementation of Genetic Algorithms | 1 | | | | | | 1 | | | | |

# Third Year

# Semester -V

### Data Visualization and Interpretation

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Data Visualization and Interpretation |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the principles of data visualization:<br>2. Develop skills in data preparation for visualization:<br>3. Create effective visualizations and to incorporate visual cues for data interpretation with clarity and accuracy of visualizations.<br>4. Learn about interactive data visualization: Students will be introduced to interactive data visualization, including tools and libraries for interactive visualization.<br>. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the importance and purpose of data visualization, and the role it plays in data analysis and decision-making.<br>CO2. 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.<br>CO3. Develop skills in a variety of visualization techniques for exploring and communicating different types of data, including distributions, correlations, and multivariate relationships.<br>CO4. Apply design principles and best practices to create effective charts, graphs, and infographics that accurately and clearly communicate insights and findings from data.<br>CO5. Develop an ethical and critical understanding of the challenges and limitations of data visualization, including issues of bias, representation, and interpretation. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | 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 |
| **UNIT2** | Data Preparation for Visualization, Understanding the importance of data preparation, Data cleaning and filtering techniques, Transforming and aggregating data, Handling missing values | CO2 |
| **UNIT3** | 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 |
| **UNIT4** | Interactive Data Visualization, Introduction to interactive data visualization, Using tools and libraries for interactive visualization, Adding interactivity to static visualizations, Designing interactive dashboards | CO4 |
| **UNIT5** | 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.*
3. Eidelman, A. (2020). Python Data Science Handbook by Jake VANDERPLAS (2016). *Statistique et Société*, *8*(2), 45-47.


**Reference Books:**


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

**DSE-I and DSE-II**

**Software Engineering using UML**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Software Engineering using UML |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | Core Course |
| **Course Objective** | The subject aims to provide the student with:<br>1. An understanding of basic concepts of Software Engineering.<br>2. An introduction to the fundamentals of Requirement Engineering.<br>3. An understanding of Object-oriented design and UML.<br>4. An introduction to Architectural Design.<br>5.An introduction to Project Management. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain the needs of Software Engineering.<br>CO2. Explain the working and importance of Requirement Engineering.<br>CO3. Demonstrate the use of object-oriented design and UML.<br>CO4. Explain the flow of Architectural Design.<br>CO5. Explain the need of Project Management. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction:** 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 |
| **UNIT2** | **Requirements engineering:** Functional and non-functional requirements: The software requirements document, Requirements specification, Requirements engineering | CO2 |

| | | |
|---|---|---|
| | processes, Requirements elicitation and analysis, Requirements validation, Requirements management | |
| **UNIT3** | **Function oriented Software Design:** SA/SD Methodology, Data Flow Diagrams, Structured Design Transformation of DFD into Structure chart, Transformation and Transaction Analysis<br>**Object-oriented design using UML:** Analysis and Design: Concepts, Classes and Objects. Relationships Among Objects. Inheritance and Polymorphism, Design Concepts, Design Notation and Specification, Design Methodology, Dynamic Modelling, Functional Modelling, Defining Internal Classes and Operations, Design patterns. | CO3 |
| **UNIT4** | **System modelling**: Context models, Interaction models, Structural models, Behavioural models Model-driven engineering.<br>**Architectural Design:** Architectural design decisions, Architectural views, Architectural patterns, Application architectures, Design and implementation,<br>**Testing**: Introduction to software testing, verification and validation, unit testing, integration testing, system testing. Software Maintenance. | CO4 |
| **UNIT5** | **Project Management:** Introduction to Risk management, managing people, Teamwork, Project planning, Software pricing, Plan-driven development, Project scheduling, Estimation techniques, Quality management, Software measurement and metrics.<br>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 | STATEMENT | 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 | Explain the needs of Software Engineering. | 2 | | | | | | | | 1 | | |
| CO2 | Explain the working and importance of Requirement Engineering. | | | 1 | | | 1 | 1 | 1 | | | |
| CO3 | Demonstrate the use of object-oriented design and UML. | | 2 | 1 | | | | | | | 1 | |
| CO4 | Explain the flow of Architectural Design. | | 1 | | | | | 1 | 1 | | | |
| CO5 | Explain the need of Project Management. | | | | | 1 | | | | 1 | | |

## Data Visualization and Interpretation -Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Data Visualization and Interpretation -Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>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. |

| | |
|---|---|
| | 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. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand and describe the main concepts of data visualization<br>CO2. Create ad-hoc reports, data visualizations, and dashboards using Tableau Desktop<br>CO3. Publish the created visualizations to Tableau Server and Tableau Public |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **Lab 1-2** | Introduction to Tableau:<br>• Course introduction<br>• Dataviz best practices<br>• Getting started with Tableau Desktop<br>• Connecting to the tutorial dataset<br>• Creating the first charts<br>• Filtering and sorting data | CO1 |
| **Lab 3-4** | Common charts:<br>• Creating common visualizations (bar charts, line charts etc.)<br>• Assembling a dashboard layout<br>• Using dashboard filters | CO2 |
| **Lab 5-6** | Transform the data:<br>• Dataviz best practices<br>• Creating simple calculations in Tableau<br>• Using table calculations | CO2 |
| **Lab 7-8** | Interactions<br>• Interactivity with text and visual tooltips<br>• Interactivity with actions (filter, highlight, URL)<br>• Drilldown between dashboards | CO2 |
| **Lab 9-10** | Advanced visualizations<br>• Dataviz best practices<br>• Creating more advanced chart types<br>• Using multiple source tables | CO3 |
| **Lab 11-12** | Data Storytelling<br>• Intro to data storytelling<br>• Creating a data story in Tableau<br>• Overview of the Tableau ecosystem<br>• Further learning opportunities | 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 by (ISBN 9781466508910)

**References Books:**

1. Scott Murray (2017) Interactive Data Visualization for the Web, 2nd Edition

Scoial Responsibily and Community Engagement

| | | |
|---|---|---|
| | Internship | 2 |

# Semester -VI

## Theory of Computation

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Theory of Computation |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages<br>2. To illustrate finite state machines to solve problems in computing<br>3. To explain the hierarchy of problems arising in the computer sciences.<br>4. To familiarize Regular grammars, context frees grammar. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. To use basic concepts of formal languages of finite automata techniques<br>CO2. Construct automata theory using Finite Automata<br>CO3. Construct context free grammar for various languages<br>CO4. Design context free grammar and Pushdown Automata<br>CO5. Explain Turing machine for computational functions |

**Course Outline**

| | |
|---|---|
| **UNIT 1** | **Introduction to TOC**<br>Mathematical Preliminaries and Notation, Three Basic Concepts (Languages, Grammars and Automata) Some Applications. |
| **UNIT 2** | **Finite Automata and its types**<br>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 |
| **UNIT 3** | **Languages and Grammars**<br>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 |

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|---|---|
| **UNIT 4** | **Context Free Languages**<br>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 |
| **UNIT 5** | **Turing Machines**<br>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 | STATEMENT | 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 | To use basic concepts of formal languages of finite automata techniques | 2 | 1 | | | | | | | 2 | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | Construct automata theory using Finite Automata | 1 | 1 | | | | | | | | | |
| CO3 | Construct context free grammar for various languages | | | | 1 | | | | | | 1 | |
| CO4 | Design context free grammar and Pushdown Automata | 1 | | | | | | 1 | | | | |
| CO5 | Explain Turing machine for computational functions | | | 1 | | | | | 1 | | | 1 |

## Block Chain Technology

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Block Chain Technology |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Define blockchain technology and explain its history.<br>2. Understand blockchain architecture, including nodes, blocks, transactions, and smart contracts.<br>3. Discuss cryptocurrencies such as Bitcoin, Ethereum, Litecoin, and others, and explain how they relate to blockchain.<br>4. Identify blockchain applications in various industries, including finance, supply chain management, healthcare, and others.<br>5. Describe security issues and potential attacks on the blockchain, including cryptography and blockchain security. |
| Course Outcome (COs) | After completion of this course students will be able to:<br>CO1. Understand the fundamental concepts of blockchain technology, including its history, key features, and types of blockchains.<br>CO2. Analyze the architecture of blockchain, including nodes, blocks, transactions.<br>CO3. Evaluate the relationship between cryptocurrencies and blockchain, including the process of mining and transaction validation. |

| | |
|---|---|
| | CO4. Analyze the current and potential applications of blockchain technology in various industries, including finance, supply chain management.<br>CO5. Understand the security and privacy issues in the blockchain eCourse Objectives system, including potential attacks and the role of cryptography in ensuring security. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | Introduction to Blockchain Technology: Definition and history of blockchain technology, Key features of blockchain technology: Decentralization, immutability, transparency, and security<br>Types of blockchain: Public, Private, and Hybrid | CO1 |
| **UNIT2** | Blockchain Architecture and Consensus Mechanisms: Understanding blockchain architecture: Nodes, blocks, transactions, and smart contracts<br>Consensus mechanisms: Proof of Work (PoW), Proof of Stake (PoS), and others Forks and their impact on the blockchain eCourse Objective system | CO2 |
| **UNIT3** | Cryptocurrencies and their relation to Blockchain: Understanding cryptocurrencies: Bitcoin, Ethereum, Litecoin, and others<br>Mining and transaction validation in the cryptocurrency eCourse Objectives system, Smart Contracts and Decentralized Applications (DApps) | CO3 |
| **UNIT4** | Blockchain Applications: Blockchain applications in finance, supply chain management, healthcare, and other industries<br>Case studies of successful blockchain implementations<br>Potential future applications of blockchain technology | CO4 |
| **UNIT5** | Blockchain Security and Privacy: Security issues and potential attacks on the blockchain, Cryptography and blockchain security<br>Privacy concerns in the blockchain e-Course Objective system | CO5 |

**Evaluation:**

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

**Text Books:**

1. Antonopoulos, A. (2014). *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*. O'Reilly Media.
2. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*. Princeton University Press

**References Books:**

1. Tapscott, D., & Tapscott, A. (2016). *Blockchain revolution: How the technology behind bitcoin is changing money, business, and the world*. Penguin.
2. Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). *An overview of blockchain technology: Architecture, consensus, and future trends*. In IEEE International Congress on Big Data (pp. 557-564). IEEE.

# Fourth Year

# Semester -VII

## RESERCH METHODOLOGY

### Advanced Machine learning

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Advanced Machine learning |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the basics of machine learning algorithms, their applications, and the<br>2. challenges involved in applying them to real-world problems.<br>3. Gain knowledge of supervised and unsupervised learning algorithms and their applications in solving classification, regression, clustering, and dimensionality reduction problems.<br>4. Learn about popular machine learning models such as decision trees, random forests, support vector machines, linear regression, logistic regression, k-means clustering, hierarchical clustering<br>5. Develop the skills required to evaluate and optimize machine learning models Explore real-world applications of machine learning in industries such as healthcare, finance, and e-commerce |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO6. Understand the definition and scope of applied machine learning, and be able to explain the different types of machine learning algorithms and their applications.<br>CO7. Develop a solid understanding of the challenges in machine learning, including data quality, feature engineering, model selection, and evaluation.<br>CO8. Be able to apply supervised learning algorithms such as decision trees, random forests, support vector machines, linear regression, and logistic regression to solve classification and regression problems. |

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|---|---|
| | CO9. Develop proficiency in unsupervised learnin techniques such as clustering and dimensionality reduction, including k-means clustering, hierarchical clustering, principal component analysis (PCA), and t-SNE.<br>CO10. Gain practical experience in deep learning techniques such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short-term memory (LSTM), and generative adversarial networks (GANs) |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Applied Machine Learning:** Definition and scope of applied machine learning, Machine learning algorithms and their applications, Challenges in machine learning: data quality, feature engineering, model selection and evaluation | CO1 |
| **UNIT2** | **Supervised Learning:** Types of supervised learning algorithms: classification and regression, Decision Trees and Random Forest, Support Vector Machines, Linear Regression. | CO2 |
| **UNIT3** | **Unsupervised Learning:** Types of unsupervised learning algorithms: clustering and dimensionality reduction, K-means Clustering, Hierarchical Clustering, Principal Component Analysis (PCA) | CO3 |
| **UNIT4** | **Deep Learning:** Introduction to Neural Networks and Deep Learning, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Generative Adversarial Networks (GANs) | CO4 |
| **UNIT5** | **Unit 5: Applied Machine Learning in Real-World Scenarios:** Deploying machine learning models in production environments, Machine learning ethics and responsible AI practices, Applications of machine learning in industries such as healthcare, finance, and e-commerce, Future trends in machine learning | CO5 |

**Evaluation:**

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

**Suggested Books:**

Alpaydin, E. (2010). Introduction to machine learning (2nd ed.). MIT Press.

**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.

**DSE-IV**

**Introduction to Big Data**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Introduction to Big Data |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | IDC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Explain the concept and importance of Big Data and its characteristics<br>2. Understand the Hadoop framework, including its architecture and components, and use MapReduce programming to process large amounts of data stored in HDFS.<br>3. Explore the Apache Spark platform, including its architecture, components, and programming model, and use RDDs and DataFrames to process and analyze large-scale datasets.<br>4. Evaluate various types of NoSQL databases, including MongoDB and Cassandra, and design data models suitable for storing and processing Big Data.<br>5. Analyze data warehousing architecture, understand the concept of business intelligence, and visualize and analyze data to gain insights into large datasets.<br>6. Interpret and communicate data effectively: Students will learn how to interpret and analyze visualized data and communicate data insights effectively. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. To introduce students to the concept of Big Data and its significance in today's world.<br>CO2. To familiarize students with the different tools and technologies used in Big Data processing.<br>CO3. To teach students how to design and implement Big Data solutions using Hadoop and Spark. |

| | |
|---|---|
| | CO4. To provide an understanding of NoSQL databases and data warehousing.<br>CO5. To equip students with the skills needed to analyze and visualize large datasets. |

**Course Outline**

| **Unit** | Description | CO Mapping |
|---|---|---|
| **UNIT1** | Introduction to Big Data and Processing: What is Big Data?, Characteristics of Big Data, Importance of Big Data in different industries, Challenges in Big Data processing | CO1 |
| **UNIT2** | Hadoop and MapReduce: Introduction to Hadoop, Hadoop Architecture and components, MapReduce Programming Model, Hadoop Distributed File System (HDFS) | CO2 |
| **UNIT3** | Apache Spark: Introduction to Spark, Spark Architecture and components, Spark Programming Model, Spark RDDs and DataFrames | CO3 |
| **UNIT4** | NoSQL Databases: Introduction to NoSQL databases, Types of NoSQL databases, MongoDB and Cassandra databases, Data modelling in NoSQL databases | CO4 |
| **UNIT5** | Data Warehousing and Analytics: Introduction to Data Warehousing, Data Warehousing Architecture, Introduction to Business Intelligence, Data Visualization and Analysis | CO5 |

**Evaluation:**

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

**Textbook:**


1. Nair, P., & Patil, M. R. (2015). *Big Data Processing with Hadoop*. Packt Publishing Ltd.
2. Marz, N., & Warren, J. (2015). *Big Data: Principles and Best Practices of Scalable Realtime Data Systems*. Manning Publications.


**Reference Book:**


1. Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015*). Learning Spark: Lightning-Fast Big Data Analysis.* O'Reilly Media.
2. Sadalage, P. J., & Fowler, M. (2012). *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. Addison-Wesley Professional.

## Cryptography and Network Security

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Cryptography and Network Security |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Develop a clear understanding of the need for security in computer systems.<br>2. Understand the principles of symmetric ciphers and how they are used to encrypt and decrypt data.<br>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.<br>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.<br>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. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>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.<br>CO2. Demonstrate knowledge of symmetric ciphers, including substitution and transposition techniques, block ciphers such as DES and Triple DES, and stream ciphers like RC4.<br>CO3. Understand the principles and need for public key cryptography, including RSA algorithm, key distribution, and management. |

| | |
|---|---|
| | CO4. Develop knowledge of different authentication requirements, including message authentication codes, hashes, and digital signatures.<br>CO5. Understand network security concepts, including firewalls, IP security, virtual private networks (VPN), intrusion detection, web security, SSL, and TLS. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction**: Need for Security, Security Attacks, Services and Mechanisms. Network Security Model | CO1 |
| **UNIT2** | **Symmetric Ciphers**: Substitution &Transposition Techniques, Block Cipher, DES, Triple DES, Stream Ciphers, RC4 | CO2 |
| **UNIT3** | **Public Key Cryptography:** Need and Principles of Public Key Cryptosystems, RSA Algorithm, Key Distribution and Management, Diffie-Hellman Key Exchange, Digital Signatures | CO3 |
| **UNIT4** | **Authentication:** Authentication Requirements, Message Authentication Codes, Hashes, MD5 & SHA, User Authentication: Password, Certificate based & Biometric Authentication, Kerberos | CO4 |
| **UNIT5** | **Network Security:** 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. Schmeier(1996) Applied Cryptography, New York, Wiley.
2. N.Koblitz: a course in number theory and cryptography, Springer verlag.


| CO | STATEMENT | 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 | Understand the need for security in computer networks, be able to identify different types of security attacks, and describe various security services and mechanisms. | 2 | | 1 | | | | | | 2 | | |
| CO2 | Demonstrate knowledge of symmetric ciphers, including substitution and transposition techniques, block ciphers such as DES and Triple DES, and stream ciphers like RC4. | | 2 | | 1 | | | | | | | |
| CO3 | Understand the principles and need for public key cryptography, including RSA algorithm, key distribution, and management. | | | | | | | 1 | 1 | | | |
| CO4 | Develop knowledge of different authentication requirements, including message authentication codes, hashes, and digital signatures. | | | | | | 1 | | | | 2 | |
| CO5 | Understand network security concepts, including firewalls, IP security, virtual private networks (VPN), intrusion detection, web security, SSL, and TLS. | | | | 1 | | | | 2 | | | 1 |

# Semester -VIII

### Information Retrieval Systems

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |

| | |
|---|---|
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Information Retrieval Systems |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Learn to write code for text indexing and retrieval.<br>2. Learn to evaluate information retrieval systems<br>3. Learn to analyze textual and semi-structured data sets<br>4. Learn to evaluate information retrieval systems<br>5. Learn about text similarity measure<br>6. Understanding about search engine |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain information retrieval systems<br>CO2. Apply IR principles to locate relevant information large collections of data<br>CO3. Design different document clustering algorithms<br>CO4. Implement retrieval systems for web search tasks<br>CO5. Design an Information Retrieval System for web search tasks. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | 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<br><br>Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities | CO1 |
| **UNIT2** | Cataloguing and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction<br><br>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 |
| **UNIT3** | Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages | CO3 |

| | | |
|---|---|---|
| | Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters | |
| **UNIT4** | User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext<br><br>Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies | CO4 |
| **UNIT5** | Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems<br><br>Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieva | 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 | STATEMENT | 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 | Explain information retrieval systems | 2 | | | | | | | | 2 | | |
| CO2 | Apply IR principles to locate relevant information large collections of data | | 1 | 1 | | | | | | | | |
| CO3 | Design different document clustering algorithms | | 1 | | | | | | | | | |
| CO4 | Implement retrieval systems for web search tasks | | | | 1 | | | | | | 1 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | Design an Information Retrieval System for web search tasks. | | | | | | 1 | | | | | 1 |

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|---|---|---|---|
| | Seminar | 2 | CC-16 |
| | Project | 6 | CC-17 |

**R programming for ML**

| | |
|---|---|
| School | Birla School of Applied Sciences |
| Programme | BSCDS |
| Batch | 2022-23 |
| Branch/Discipline | BSCDS |
| Semester | |
| Course Title | R Programming for ML |
| Course Code | |
| Credit | L-T-P- 3-1-0 Total Credit - 4 |
| Course Type | IDC |
| Course Objective | The subject aims to provide the student with:<br>1. To introduce students to the R programming language:<br>2. To teach students how to preprocess and wrangle data in R:<br>3. To equip students with knowledge of supervised learning algorithms.<br>4. To teach students about unsupervised learning algorithms:<br>5. To teach students about model evaluation and deployment in R: |
| Course Outcome (COs) | After completion of this course students will be able to:<br>CO1. Understand the fundamentals of R programming language: Students will gain a solid understanding of the basics of R programming.<br>CO2. Develop skills in data preprocessing and wrangling: Students will learn how to clean and preprocess data using R.<br>CO3. Gain proficiency in supervised learning algorithms: Students will learn about popular supervised learning algorithms such as linear regression, logistic regression, decision trees, random forests, and support vector machines. |

| | |
|---|---|
| | CO4. Learn about unsupervised learning algorithms: Students will gain knowledge of unsupervised learning algorithms such as clustering and principal component analysis (PCA)<br>CO5. Understand model evaluation and deployment in R. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| UNIT1 | Introduction to R Programming Language: Overview of R programming language, Data types and data structures in R, R packages and libraries, Basic data manipulation in R | CO1 |
| UNIT2 | Preprocessing and Data Wrangling with R: Data cleaning and preprocessing in R, Data visualization with ggplot2, Feature selection and engineering | CO2 |
| UNIT3 | Supervised Learning Algorithms with R: Linear regression, Logistic regression, Decision trees, Random forests, Support vector machines | CO3 |
| UNIT4 | Unsupervised Learning Algorithms with R: Clustering, Principal Component Analysis (PCA) | CO4 |
| UNIT5 | Model Evaluation and Deployment with R: Model evaluation and validation techniques, Model deployment in R, Best practices for reproducibility and collaboration in R programming | CO5 |

Evaluation:

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

**Text Book**


1. Wickham, H., & Grolemund, G. (2017). *R for Data Science*. O'Reilly Media.
2. Boehmke, B. C. (2016). *Data Wrangling with R*. Springer International Publishing.


**Reference Book**


1. Kuhn, M. & Johnson, K. (2013). Applied Predictive Modeling. Springer.

2. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2017). *An Introduction to Statistical Learning with Applications in R.* Springer.
3.

| | | |
|---|---|---|
| | Seminar/Research Report writing and presentation | 2 |
| | Research Report/ Industrial Training | 10 |

**Elective Third Year - DSE-I-II-III**

**Digital Image Processing**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Digital Image Processing |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To understand the sensing, acquisition and storage of digital images.<br>2. To understand the digital processing systems and corresponding terminology.<br>3. To understand the base image transformation domains and methods.<br>4. To study the image enhancement techniques.<br>5. To have an understanding of colour models, type of image representations and related statistics.<br>6. To study image compression procedures and morphological image processing. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain digital image fundamentals and image acquisition<br>CO2. Explain the image processing requirements and mathematical transforms necessary for image processing.<br>CO3. Explain image enhancement and restoration techniques |

| | |
|---|---|
| | CO4. Explain handling colour image processing and image compression techniques<br>CO5. Explain morphological image processing |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | Introduction to image processing: Fundamentals, Applications, Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbors of pixel adjacency connectivity, regions and boundaries, Distance measures | CO1 |
| **UNIT2** | Image Transforms – Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform | CO2 |
| **UNIT3** | Image Enhancement: Frequency and Spatial Domain, Contrast Stretching, Histogram Equalization, Low pass and High pass filtering.<br>Image Restoration: Noise models, mean, order-statistics adaptive filters, Band reject, Band pass and notch filters | CO3 |
| **UNIT4** | Color Image Processing: Color models, Color transformation and segmentation<br>Image Compression: Fundamentals, Models, Error free and lossy compression, Standards. | CO4 |
| **UNIT5** | Morphological Image Processing: Overview, Boundary extraction, Region filtering, Connected component extraction, Convex hull, Thinning; Thickening; skeletons; pruning; Image segmentation | CO5 |

**Evaluation:**

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

**Text Books:**

1. Rafael C.Gonzalez & Richard E.Woods (2004),Digital Image Processing ,Pearson Education.

2. Anil.K.Jain – (2003)Fundamentals of Digital Image Processing- Pearson Education.

**Reference Books:**

1. B.Chanda & D.Dutta Majumder (2002)Digital Image Processing and Analysis ,Prentice Hall of India.

2. William K. Pratt,( 2002) Digital Image Processing – John Wiley & SonS.

| CO | STATEMENT | 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 | Explain digital image fundamentals and image acquisition | 2 | | | | | | | | 2 | | |
| CO2 | Explain the image processing requirements and mathematical transforms necessary for image processing. | | 1 | 1 | 1 | | | | | | | |
| CO3 | Explain image enhancement and restoration techniques | | | | 1 | | | | | 2 | | |
| CO4 | Explain handling colour image processing and image compression techniques | | | | 1 | | | | 1 | | | |

## Digital Image Processing Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | DS |
| **Semester** | |
| **Course Title** | Digital Image Processing Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | CC |
| **Course Objective** | 3. To understand the fundamental concepts of image processing and its applications. |

| | |
|---|---|
| | 4. To learn and implement histogram equalization techniques for improving image contrast.<br>5. To implement spatial domain smoothing or averaging filters and evaluate their effects on the image quality.<br>6. To implement opening and closing operations for image enhancement and noise reduction.<br>7. To learn and implement edge detection algorithms for detecting and highlighting edges in the image. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO6. Students will be able to explain the concept of image processing and its importance in various fields.<br>CO7. Students will be able to apply histogram equalization to enhance the contrast of an image.<br>CO8. Students will be able to implement smoothing or averaging filters to reduce noise in images.<br>CO9. Students will be able to use opening and closing operations to remove small objects and fill small holes in images.<br>CO10. Students will be able to apply edge detection algorithms to identify edges and contours in images. |

**Course Outline**

| **Unit** | **Description** | **CO Mapping** |
|---|---|---|
| **Lab-1** | To study the Image Processing concept. | CO1 |
| **Lab-2** | To obtain histogram equalization image. | CO2 |
| **Lab-3** | To Implement smoothing or averaging filter in spatial domain. | CO2 |
| **Lab-4** | Program for opening and closing of the image. | CO2 |
| **Lab-5** | To fill the region of interest for the image. | CO2 |
| **Lab-6** | Program for edge detection algorithm. | CO3 |
| **Lab-7** | Program of sharpen image using gradient mask. | C04 |
| **Lab-8-9** | Program for morphological operation: erosion and dilation | CO4, CO5 |
| **Lab-10-12** | Program for DCT/IDCT computation | CO2, CO3 |

**Evaluation:**

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

**Text Books:**

1. Rafael C.Gonzalez & Richard E.Woods (2004),Digital Image Processing ,Pearson Education.

2. Anil.K.Jain – (2003)Fundamentals of Digital Image Processing- Pearson Education.

**Reference Books:**

1. B.Chanda & D.Dutta Majumder (2002)Digital Image Processing and Analysis ,Prentice Hall of India.
2. William K. Pratt ,( 2002) Digital Image Processing – John Wiley & SonS

| CO | STATEMENT | 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 | Demonstrate an understanding of the importance of the IoT ecosystem. | 2 | | 1 | | | | | | 1 | | |
| CO2 | Analyze and compare IoT protocols, including M2M and WSN. | 1 | 1 | 1 | | | | | 1 | | | |
| CO3 | Design and implement an IoT architecture, including the OIC architecture and design principles. | | 2 | 1 | | | | | 1 | | 2 | |
| CO4 | Evaluate and compare Web of Things (WoT) and Internet of Things (IoT) architectures. | | 1 | | 2 | | | 1 | | | | |
| CO5 | Develop and implement IoT applications for industry, including future factory concepts. | | | | 1 | | 1 | 1 | | | | 1 |

## Cloud Computing Management

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Cloud Computing Management |
| **Course Code** | |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To introduce the concept of cloud computing and its evolution.<br>2. To provide an understanding of different deployment and service models of cloud computing.<br>3. To familiarize students with cloud infrastructure management, including virtualization, storage, network, security, and disaster recovery.<br>4. To enable students to manage cloud services effectively, including SLAs, governance, migration, integration, and optimization.<br>5. To equip students with the knowledge of cloud application development and deployment, including architectures, design patterns, tools, testing, deployment, and DevOps practices. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Students will be able to describe the concept and evolution of cloud computing, and identify the benefits and challenges of cloud computing.<br>CO2. Students will be able to differentiate between different deployment and service models of cloud computing and their applications.<br>CO3. Students will be able to manage cloud infrastructure effectively, including virtualization, storage, network, security, and disaster recovery.<br>CO4. Students will be able to manage cloud services effectively, including SLAs, governance, migration, integration, and optimization.<br>CO5. Students will be able to develop and deploy cloud applications using different architectures, design patterns, tools, testing, deployment, and DevOps practices. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Cloud Computing:** Definition and evolution of cloud computing, Cloud deployment models: public, private, hybrid, Service models: IaaS, PaaS, SaaS, Cloud characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity, measured service, Cloud benefits and challenges | CO1 |
| **UNIT2** | **Cloud Infrastructure Management:** Virtualization and hypervisors, Cloud storage and data management, Network management in the cloud, Security and privacy in the cloud, Disaster recovery and business continuity in the cloud | CO2 |
| **UNIT3** | **Cloud Service Management:** Service-level agreements (SLAs) and governance, Cloud service providers and marketplace, Cloud migration strategies and challenges, Cloud service integration and customization, Cloud performance and cost optimization | CO3 |
| **UNIT4** | **Cloud Application Development and Deployment:** Cloud application architectures and design patterns, Cloud application development tools and frameworks, Cloud application testing and deployment strategies, Microservices and serverless computing in the cloud, Cloud-native application development and DevOps practices | CO4 |
| **UNIT5** | **Cloud Business Management:** Cloud economics and cost modelling, Cloud vendor management and contract negotiation, Cloud compliance and regulatory issues, Cloud adoption and transformation strategies, Cloud innovation and future trends | CO5 |

**Evaluation:**

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

**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.


## Cloud Computing Management Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | DS |
| **Semester** | |
| **Course Title** | Cloud Computing Lab |
| **Course Code** | |
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | CC |
| **Course Objective** | 1. To learn to use version control systems<br>2. To create web applications in the cloud<br>3. To learn about virtual machines and work with them<br>4. To learn how to design and build a cloud-based application.<br>5. To learn how to use Hadoop to implement and use parallel programming |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Configure various virtualization tools such as Virtual Box, VMware workstation.<br>CO2. Design and deploy a web application in a PaaS environment.<br>CO3. Learn how to simulate a cloud environment to implement new schedulers.<br>CO4. Install and use a generic cloud environment that can be used as a private cloud.<br>CO5. Install and use Hadoop |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **Lab-1** | Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows | CO1 |
| **Lab-2** | Pro Install a C compiler in the virtual machine created using virtual box and execute Simple Programs | CO2 |
| **Lab-3** | Install Google App Engine. Create hello world app and other simple web applications using python/java. | CO2 |
| **Lab-4** | Use GAE launcher to launch the web applications | CO2 |
| **Lab-5** | Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. | CO2 |
| **Lab-6 -7** | Find a procedure to transfer the files from one virtual machine to another virtual machine. | CO3 |
| **Lab-8-9** | Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version) | C04 |
| **Lab-10-12** | 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:**


3. Mishra, A., & Mohanty, S. P. (2018). Cloud computing: principles and paradigms. John Wiley and Sons.

**4.** Judith S. Hurwitz, Daniel Kirsch ,(2020),Cloud Computing for Dummies,


**Reference Books:**


3. Jamsa, K. A. (2018). Cloud computing: SaaS, PaaS, IaaS, virtualization, business models, mobile, security and more. Jones Bartlett Learning.

4. 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.

## High Performance Computing

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | High Performance Computing |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Define and explain the concept of high-performance computing, its historical development.<br>2. Understand the components of high-performance computing systems and their roles.<br>3. Identify different types of parallel computing architectures and programming paradigms.<br>4. Explore the architecture and types of high-performance computing clusters.<br>5. Acquire knowledge of high-performance computing platforms and tools, including their evaluation and analysis. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the fundamental concepts of High Performance Computing.<br>CO2. Identify different types of parallel computing and understand the parallel computing architecture and parallel processing models.<br>CO3. Analyze cluster architecture, cluster types and topologies.<br>CO4. Utilize various high-performance computing platforms and tools.<br>CO5. Apply High Performance Computing in scientific and engineering applications, artificial intelligence and machine learning, big data analytics, and cloud computing. |

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to High Performance Computing**: 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 |
| **UNIT2** | **Parallel Computing**: Types of Parallel Computing, Parallel Computing Architecture, Parallel Processing Models, Parallel Programming Paradigms | CO2 |
| **UNIT3** | **High Performance Computing Clusters**: Cluster Architecture, Cluster Types and Topologies, Parallel Programming in Clusters, Job Scheduling and Resource Management in Clusters | CO3 |
| **UNIT4** | **High Performance Computing Platforms and Tools**: High Performance Computing Platforms, Performance Evaluation and Analysis, High Performance Computing Tools and Libraries<br>MPI and OpenMP Programming Models | CO4 |
| **UNIT5** | **Applications of High-Performance Computing**: 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 | STATEMENT | 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 | Understand the fundamental concepts of High Performance Computing. | 2 | | 1 | | | | | | 1 | | |
| CO2 | Identify different types of parallel computing and understand the parallel computing architecture and parallel processing models. | 2 | | | | | | | | | | |
| CO3 | Analyze cluster architecture, cluster types and topologies. | 1 | | | | | | | | | 1 | |
| CO4 | Utilize various high-performance computing platforms and tools. | | | | 2 | | | | | | | |
| CO5 | Apply High Performance Computing in scientific and engineering applications, artificial intelligence and machine learning, big data analytics, and cloud computing. | 2 | | | | | 1 | 1 | 1 | 1 | | |

## Introduction to IOT

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Introduction to IoT |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | Core Course |
| **Course Objective** | The subject aims to provide the student with: |

| | |
|---|---|
| | 2. To gain a comprehensive understanding of the IoT ecosystem.<br>3. To learn about IoT protocols, standardization efforts, M2M and WSN, SCADA and RFID protocols.<br>4. To comprehend IoT architecture, open-source architecture (OIC), design principles, IoT devices and deployment models.<br>5. To understand the differences between Web of Things and Internet of Things.<br>6. To explore IoT applications for the industry, future factory concepts. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Demonstrate an understanding of the importance of the IoT ecosystem.<br>CO2. Analyze and compare IoT protocols, including M2M and WSN.<br>CO3. Design and implement an IoT architecture, including the OIC architecture and design principles.<br>CO4. Evaluate and compare Web of Things (WoT) and Internet of Things (IoT) architectures.<br>CO5. Develop and implement IoT applications for industry, including future factory concepts. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **IOT** - 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 |
| **UNIT2** | **IOT PROTOCOLS** - Protocol Standardization for IoT – Efforts – M2M and WSN, Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards –Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security | CO2 |
| **UNIT3** | **IOT ARCHITECTURE** - 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 |

| | | |
|---|---|---|
| **UNIT4** | **WEB OF THINGS** - Web of Things versus Internet of Things – Two Pillars of the Web, – Architecture StandardizationforWoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals andBusiness Intelligence. | CO4 |
| **UNIT5** | **IOT APPLICATIONS** - 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 ofThings", Springer.

**Reference Books:**

1. Vijay Madisetti and ArshdeepBahga, (2014) "Internet of Things (A Hands-on-Approach)",1st Edition,VPT,

| **2.** | | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **STATEMENT** | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Demonstrate an understanding of the importance of the IoT ecosystem. | 2 | | 1 | | | | | | 1 | | |
| CO2 | Analyze and compare IoT protocols, including M2M and WSN. | 1 | 1 | 1 | | | | | 1 | | | |
| CO3 | Design and implement an IoT architecture, including the OIC architecture and design principles. | | 2 | 1 | | | | | 1 | | 2 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | Evaluate and compare Web of Things (WoT) and Internet of Things (IoT) architectures. | | 1 | | 2 | | | 1 | | | | |
| CO5 | Develop and implement IoT applications for industry, including future factory concepts. | | | | 1 | | 1 | 1 | | | | 1 |

## Mobile Computing

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Mobile Computing |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To understand the basic concepts of mobile computing.<br>2. To learn the basics of mobile telecommunication system.<br>3. To be familiar with the network layer protocols and Ad-Hoc networks.<br>4. To know the basis of transport and application layer protocols.<br>5. To gain knowledge about different mobile platforms and application development |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Explain the basics of mobile telecommunication systems<br>CO2. Illustrate the generations of telecommunication systems in wireless networks<br>CO3. Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network<br>CO4. Explain the functionality of Transport and Application layers<br>CO5. Develop a mobile application using android/blackberry/ios/Windows SDK / Explain the 5G network Architechture |

| | **Description** | **CO Mapping** |
|---|---|---|
| **UNIT1** | **Introduction:** Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication | CO1 |

| | | |
|---|---|---|
| | Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA | |
| **UNIT2** | **Mobile Telecommunication System:** Introduction to Cellular Systems - GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover – Security | CO2 |
| **UNIT3** | **Mobile Network Layer:** Mobile IP – DHCP – adhoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks ( VANET) –MANET Vs VANET – Security | CO3 |
| **UNIT4** | **Mobile Transport And Application Layer:** Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WM | CO4 |
| **UNIT5** | **Mobile Platforms And Applications:** 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 |
| **UNIT6** | 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 | STATEMENT | 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 | Explain the basics of mobile telecommunication systems | 2 | | | | | | | | 2 | | |
| CO2 | Illustrate the generations of telecommunication systems in wireless networks | 2 | | 1 | | | | | | | | |
| CO3 | Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network | | 1 | 1 | | | | | 1 | | 1 | |
| CO4 | Explain the functionality of Transport and Application layers | 1 | | | | | | | | | | |
| CO5 | Develop a mobile application using android/blackberry/ios/Windows SDK / Explain the 5G network Architechture | | | | 2 | 1 | | 1 | | 1 | | |

## Natural Language Processing

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Natural Language Processing |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the definition and scope of NLP and the challenges involved in NLP such as ambiguity, syntax, semantics, and pragmatics.<br>2. Gain knowledge about various applications of NLP such as language translation, sentiment analysis, chatbots, and information retrieval.<br>3. Learn text pre-processing techniques such as tokenization, stemming, lemmatization, POS tagging, NER, and stop word removal.<br>4. Understand different text representation models such as bag-of-words, n-gram, vector space model, and word embeddings.<br>5. Gain knowledge about language modelling, probability theory, n-gram language models. |

| | |
|---|---|
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the fundamental concepts and challenges in Natural Language Processing.<br>CO2. Demonstrate proficiency in text pre-processing techniques, including word and sentence tokenization, stemming and lemmatization, part-of-speech (POS) tagging, named entity recognition (NER), and stop word removal.<br>CO3. Analyze and represent text data using various models.<br>CO4. Develop proficiency in language modeling using probability theory.<br>CO5. Demonstrate an understanding of syntax and semantics. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to NLP:** Definition and scope of NLP, Challenges in NLP: ambiguity, syntax, semantics, pragmatics, Applications of NLP: language translation, sentiment analysis, chatbots, information retrieval | CO1 |
| **UNIT2** | **Text Preprocessing:** Tokenization: word and sentence tokenization, Stemming and Lemmatization<br>Part-of-Speech (POS) tagging, Named Entity Recognition (NER), Stop word removal Feature engineering for text data | CO2 |
| **UNIT3** | **Text Representation:** Bag-of-words model, N-gram model, Vector space model, Document-term matrix, TF-IDF weighting, Word embeddings: word2vec and GloVe | CO3 |
| **UNIT4** | **Language Modeling:** Probability theory and language modelling, N-gram language models, Perplexity as evaluation metric, Smoothing techniques: Laplace smoothing, Good-Turing smoothing, Kneser-Ney smoothing, | CO4 |
| **UNIT5** | **Syntax and Semantics:** Context-Free Grammars (CFGs), Parsing techniques: top-down and bottom-up parsing, Dependency parsing, Sentiment analysis: classification, lexicon-based methods, Named entity recognition and disambiguation | CO5 |

**Evaluation:**

| | | |
|---|---|---|
| Mode of Evaluation | Theory | |
| Weightage | Continuous Evaluation | End Semester Examination |

| | | |
|---|---|---|
| | 40 | 60 |

**Text Books:**


1. Steven Bird, Ewan Klein, Edward Loper,( 2018) Natural Language Processing with Python Analyzing Text with the Natural Language Toolkit (O'Reilly 2009)

2. Dipanjan Sarkar,( 2016) Text Analytics with Python (Apress/Springer)


| CO | STATEMENT | 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 | Understand the fundamental concepts and challenges in Natural Language Processing. | 2 | | | | | | | | | | 1 |
| CO2 | Demonstrate proficiency in text preprocessing techniques, including word and sentence tokenization, stemming and lemmatization, part-of-speech (POS) tagging, named entity recognition (NER), and stop word removal. | | 1 | 1 | | | | | | | | |
| CO3 | Analyze and represent text data using various models. | | 1 | | 1 | | | | | | 1 | |
| CO4 | Develop proficiency in language modeling using probability theory. | 1 | | | | | | | | | | |
| CO5 | Demonstrate an understanding of syntax and semantics. | | | | 2 | | 1 | | | 2 | | |

Cyber Security and Privacy

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BCA |
| **Batch** | 2023-26 |
| **Branch/Discipline** | Multidisciplinary Courses |
| **Semester** | NA |
| **Course Title** | Cyber Security and Privacy |
| **Course Code** | CSMDC - 101 |

| | |
|---|---|
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the importance of cybersecurity and the impact of cyber-attacks on organizations and individuals.<br>2. Recognize different types of cyber threats and attacks, such as malware, viruses, and ransomware, and understand how to mitigate them.<br>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.<br>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.<br>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. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the definition of Cybersecurity and the importance of protecting digital assets.<br>CO2. Recognize various types of Cybersecurity threats and attacks, and apply risk management principles to assess and mitigate potential vulnerabilities.<br>CO3. Explain basic Cryptography and encryption concepts, network security, firewalls, and identify security tools used in Cybersecurity.<br>CO4. Develop Information Security policies and procedures, incident response planning, and management, and evaluate compliance with regulatory requirements.<br>CO5. Analyze emerging Cybersecurity threats and trends, evaluate the latest Cybersecurity technologies, and understand ethical considerations in Cybersecurity. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Cybersecurity**: Definition of Cybersecurity ,Importance of Cybersecurity, Cybersecurity threats and attacks, Overview of Cybersecurity frameworks and standards ,Basic principles of Cybersecurity | CO1 |

| | | |
|---|---|---|
| **UNIT2** | **Network Security**: Fundamentals of network security, Types of network security threats, Network security protocols and technologies, Network security best practices | CO2 |
| **UNIT3** | **Cybersecurity Technologies and Tools**: 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 |
| **UNIT4** | **Cybersecurity Policies and Procedures**: Information security policies and procedures, Incident response planning and management, Security awareness and training, Physical security considerations, Compliance and regulatory requirements | CO4 |
| **UNIT5** | **Future of Cybersecurity**: 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 | STATEMENT | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Understand the definition of Cybersecurity and the importance of protecting digital assets. | 2 | | | | | | | | 2 | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | Recognize various types of Cybersecurity threats and attacks, and apply risk management principles to assess and mitigate potential vulnerabilities. | | 1 | 1 | | | | | | 2 | | |
| CO3 | Explain basic Cryptography and encryption concepts, network security, firewalls, and identify security tools used in Cybersecurity. | | | | | | | 1 | 1 | | | |
| CO4 | Develop Information Security policies and procedures, incident response planning, and management, and evaluate compliance with regulatory requirements. | | | | 1 | 2 | | | 1 | | | |
| CO5 | Analyze emerging Cybersecurity threats and trends, evaluate the latest Cybersecurity technologies, and understand ethical considerations in Cybersecurity. | | | | 2 | | | 1 | | | | 2 |

## Cyber Security and Privacy

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BCA |
| **Batch** | 2023-26 |
| **Branch/Discipline** | Multidisciplinary Courses |
| **Semester** | NA |
| **Course Title** | Cyber Security and Privacy |
| **Course Code** | CSMDC - 101 |
| **Credit** | L-T-P- 3-0-0 Total Credit - 3 |

| | |
|---|---|
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the importance of cybersecurity and the impact of cyber-attacks on organizations and individuals.<br>2. Recognize different types of cyber threats and attacks, such as malware, viruses, and ransomware, and understand how to mitigate them.<br>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.<br>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.<br>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. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO6. Understand the definition of Cybersecurity and the importance of protecting digital assets.<br>CO7. Recognize various types of Cybersecurity threats and attacks, and apply risk management principles to assess and mitigate potential vulnerabilities.<br>CO8. Explain basic Cryptography and encryption concepts, network security, firewalls, and identify security tools used in Cybersecurity.<br>CO9. Develop Information Security policies and procedures, incident response planning, and management, and evaluate compliance with regulatory requirements.<br>CO10. Analyze emerging Cybersecurity threats and trends, evaluate the latest Cybersecurity technologies, and understand ethical considerations in Cybersecurity. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Cybersecurity**: Definition of Cybersecurity ,Importance of Cybersecurity, Cybersecurity threats and attacks, Overview of Cybersecurity frameworks and standards ,Basic principles of Cybersecurity | CO1 |
| **UNIT2** | **Network Security**: Fundamentals of network security, Types of network security threats, Network security protocols and technologies, Network security best practices | CO2 |

| | | |
|---|---|---|
| **UNIT3** | **Cybersecurity Technologies and Tools**: 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 |
| **UNIT4** | **Cybersecurity Policies and Procedures**: Information security policies and procedures, Incident response planning and management, Security awareness and training, Physical security considerations, Compliance and regulatory requirements | CO4 |
| **UNIT5** | **Future of Cybersecurity**: 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 | STATEMENT | CORRELATION WITH PROGRAM OUTCOMES | | | | | | | | CORRELATION WITH PROGRAM SPECIFIC OUTCOMES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | Understand the definition of Cybersecurity and the importance of protecting digital assets. | 2 | | | | | | | | 2 | | |
| CO2 | Recognize various types of Cybersecurity threats and attacks, and apply risk management principles to assess | | 1 | 1 | | | | | | | 2 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | and mitigate potential vulnerabilities. | | | | | | | | | | | |
| CO3 | Explain basic Cryptography and encryption concepts, network security, firewalls, and identify security tools used in Cybersecurity. | | | | | | | 1 | 1 | | | |
| CO4 | Develop Information Security policies and procedures, incident response planning, and management, and evaluate compliance with regulatory requirements. | | | | 1 | 2 | | | 1 | | | |
| CO5 | Analyze emerging Cybersecurity threats and trends, evaluate the latest Cybersecurity technologies, and understand ethical considerations in Cybersecurity. | | | | 2 | | | 1 | | | | 2 |

## Mobile App Development Lab

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BCA |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BCA |
| **Semester** | |
| **Course Title** | Mobile App Development Lab |
| **Course Code** | |

| | |
|---|---|
| **Credit** | L-T-P- 0-0-2 Total Credit - 1 |
| **Course Type** | CC |
| **Course Objective** | 1. To introduce students to the Android Studio environment and its components.<br>2. To develop basic Android applications using Java programming language and the Android SDK.<br>3. To teach students how to design user interfaces using various layouts and widgets.<br>4. To demonstrate the use of Intents for data transfer between different activities and applications.<br>5. To teach students how to use Android& built-in components for SMS, menu, registration, and fragments. |
| **Course Outcome (COs)** | CO1. Install and configure Android Studio to develop Android applications<br>CO2. Development of basic applications<br>CO3. Understand to design pass by value using intend and buttons<br>CO4. Design and understand user interfaces using various Android components such as text fields, radio buttons, and spinners<br>CO5. Develop Android applications to understand user database tables |

**Course Outline**

| **Lab** | **Description** | **CO Mapping** |
|---|---|---|
| **Lab :1** | Installation of Android studio. | **CO1** |
| **Lab :2** | Development Of Hello World Application | **CO2** |
| **Lab :3** | Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button | **CO2** |
| **Lab :4** | Create a screen that has input boxes for User Name, Password, Address, Gender(radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button (use any layout) | **CO2** |
| **Lab :5** | Design an android application to create page using Intent and one Button and pass the Values from one Activity to second Activity | **CO3** |
| **Lab :6** | Design an android application Send SMS using Intent | **CO3** |
| **Lab :7** | Create an android application using Fragments | **CO4** |
| **Lab :8** | Design an android application Using Radiobuttons | **CO4** |
| **Lab :9** | Design an android application for menu. | **CO4** |

| | | |
|---|---|---|
| **Lab :10** | Create a user registration application that stores the user details in a database table. | **CO5** |

**Evaluation:**

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

**Suggested 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

| CO | STATEMENT | 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 | Install and configure Android Studio to develop Android applications | 2 | 1 | | | | | | 1 | 1 | | |
| CO2 | Development of basic applications | | 1 | | | | | | | | | |
| CO3 | Understand to design pass by value using intend and buttons | | 1 | 1 | | 1 | | | | | 1 | |
| CO4 | Design and understand user interfaces using various Android components such as text fields, radio buttons, and spinners | | | | | | | 1 | 1 | | | |
| CO5 | Develop Android applications to understand user database tables | | | | | | 1 | | 1 | | | 1 |

**Arduino and Raspberry pi**

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BCA |
| **Batch** | 2023-26 |
| Branch/Discipline | BCA |
| **Semester** | |
| **Course Title** | Arduino and Raspberry Pi |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. To program Arduino to control lights, motors, and other devices.<br>2. To learn Arduino's architecture, including inputs and connectors for add-on devices.<br>3. To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.<br>4. To understand various options in programming languages, from C to drag-and-drop languages.<br>5. To test, debug, and deploy the Arduino to solve real world problems. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Recall the basics of sensors, its functioning.<br>CO2. Execute basic and advanced assembly language programs.<br>CO3. Learn the ways to interface I/O devices with processor for task sharing.<br>CO4. Recall the basics of co-processor and its ways to handle float values by its instruction set. Recognize the functionality of micro controller, latest version processors and its applications.<br>CO5. Acquire design thinking capability, ability to design a component with realistic constraints |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to sensors**<br>Transducers, Classification, Roles of sensors in IOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators. | CO1 |

| | | |
|---|---|---|
| **UNIT2** | **Hardware**<br>Physical device – Arduino Interfaces, Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface,<br>–Programming, APIs/Packages-Quark SOC processor, programming, Arduino Boards using GPIO (LED, LCD, Keypad, Motor control and sensor) | CO2 |
| **UNIT3** | **Platforms**<br>History - Creative Coding Platforms - Open Source Platforms – PIC - Arduino, Sketch, Iterative coding methodology – Python Programming - Mobile phones and similar devices –<br>Arm Devices - Basic Electronics (circuit theory, measurements, parts identification) Sensors and Software: Understanding Processing Code Structure, variables and flow control,<br>Interfacing to the Real World | CO3 |
| **UNIT4** | **Programming an Arduino IoT Device**<br>Preparing the development environment (Arduino IDE), Exploring the Arduino language (C/C++) syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, WiFi Modules and I2C and SPI,<br>Interfacing arduino and Blynk via USB: LED Blinking, Controlling a Servomotor. | CO4 |
| **UNIT5** | **Programming ESP 8266 Module**<br>ESP8266 WiFi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor,<br>Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via ThingSpeak, Connecting Your Arduino Set-up to Blynk via WiFi | CO5 |

**Evaluation:**

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

**Text Books:**


1. Sheth, A. P., & Anantharam, P. (Eds.). (2017). Handbook of research on IoT design and implementation paradigms. IGI Global.

2. Li, S., Da Xu, L., & Zhao, S. (2017). The internet of things: from RFID to the next-generation pervasive networked systems. CRC Press.


**Reference Books:**

1. Atzori, L., Iera, A., & Morabito, G. (2017). The internet of things: a survey. Computer networks, 54(15), 2787-2805.

2. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems, 29(7), 1645-1660.

| CO | STATEMENT | 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 | Recall the basics of sensors, its functioning. | 2 | | | | | | | | | | |
| CO2 | Execute basic and advanced assembly language programs. | | 1 | | | | | | | 1 | | |
| CO3 | Learn the ways to interface I/O devices with processor for task sharing. | | | | | 1 | 1 | | | | | |
| CO4 | Recall the basics of co-processor and its ways to handle float values by its instruction set. Recognize the functionality of micro controller, latest version processors and its applications. | 2 | | 1 | | | | | | | 2 | |
| CO5 | Acquire design thinking capability, ability to design a component with realistic constraints | | 1 | | 2 | | | | | | | 1 |

**ELECTIVE- 4TH YEAR- DSE-4**

**DSE-4**

## Computer Vision

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2023-26 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |

| | |
|---|---|
| **Course Title** | Computer Vision |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the basic concepts and applications of computer vision, including its history and evolution, image formation, and sensing.<br>2. Learn about image processing techniques such as point processing operations, histogram processing, and image filtering, and their use in enhancing images.<br>3. Gain knowledge of feature extraction and analysis techniques used in computer vision, including feature matching algorithms, object recognition and detection, and object tracking.<br>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.<br>5. Explore the real-world applications of computer vision, including medical imaging, surveillance and security, autonomous vehicles and drones, and virtual and augmented reality. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the definition, scope, and applications of Computer Vision, and the evolution of Computer Vision over time.<br>CO2. Develop a working knowledge of image formation, sensing, and basic image processing techniques.<br>CO3. Understand and apply feature extraction techniques, feature matching algorithms, and object recognition and detection methods in Computer Vision.<br>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.<br>CO5. Develop a practical understanding of the real-world applications of Computer Vision. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | **Introduction to Computer Vision:** Definition and scope of Computer Vision, History and evolution of Computer Vision: Applications of Computer Vision, Image Formation and Sensing, Image Processing Basics | CO1 |
| **UNIT2** | **Image Processing Techniques:** Point processing operations, Histogram processing, Image filtering, Edge detection. Image segmentation | CO2 |

| | | |
|---|---|---|
| **UNIT3** | **Feature Extraction and Analysis:** Feature extraction techniques, Feature matching algorithms, Object recognition and detection, Object tracking, | CO3 |
| **UNIT4** | **Machine Learning in Computer Vision:** Introduction to machine learning in Computer vision, Supervised and unsupervised learning techniques, Deep learning models in computer vision (CNNs, RNNs, etc.), Transfer learning | CO4 |
| **UNIT5** | **Applications of Computer Vision:** 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:**

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

**Reference Books:**

1. Prince, S. J. D. (2012). Computer Vision: Models, Learning, and Inference. Cambridge University Press.
2. Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.
3. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.

## Robotics and Intelligent System

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSCDS |
| **Batch** | 2022-23 |
| **Branch/Discipline** | BSCDS |
| **Semester** | |
| **Course Title** | Robotics and Intelligent System |
| **Course Code** | |
| **Credit** | L-T-P- 3-1-0 Total Credit - 4 |

| | |
|---|---|
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the fundamentals of robotics and intelligent systems.<br>2. Develop skills in robot kinematics and dynamics.<br>3. Gain proficiency in computer vision and image processing for robotics.<br>4. Learn about intelligent control of robots: Students will gain knowledge of intelligent control systems, including fuzzy logic control, artificial neural networks, reinforcement learning, and adaptive control.<br>5. Understand the applications of robotics and intelligent systems. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Define the key concepts and historical development of robotics and intelligent systems, and explain their current and potential applications in various domains.<br>CO2. Apply kinematics and dynamics principles to design and control the motion of robots in a given task or environment.<br>CO3. Utilize computer vision and image processing techniques to extract information from visual data and enable robots to perform navigation, manipulation, and inspection tasks.<br>CO4. Evaluate and implement intelligent control systems for robots using fuzzy logic, artificial neural networks, reinforcement learning, and advanced control techniques.<br>CO5. Analyze and discuss the ethical and safety concerns related to the design, deployment, and use of robotics and intelligent systems in different contexts. |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | Introduction to Robotics and Intelligent Systems, Definition and history of robotics and intelligent systems, Types of robots and their applications. Components of a robot: sensors, actuators, controllers, Overview of intelligent systems: machine learning, artificial intelligence, and neural networks, Ethics and safety concerns in robotics and intelligent systems | CO1 |
| **UNIT2** | Robot Kinematics and Dynamics, Basic concepts of robot kinematics and dynamics, Forward and inverse kinematics Newton-Euler equations of motion, Trajectory planning and control, Robot programming languages: MATLAB, Python, and ROS | CO2 |
| **UNIT3** | Computer Vision and Image Processing for Robotics, Fundamentals of computer vision and image processing, Image acquisition and processing techniques, Feature extraction and recognition, Object detection and tracking, Applications of | CO3 |

| | | |
|---|---|---|
| | computer vision in robotics: navigation, manipulation, and inspection | |
| **UNIT4** | Intelligent Control of Robots, Introduction to intelligent control systems, Fuzzy logic control and its applications in robotics, Artificial neural networks for robot control, Reinforcement learning and adaptive control, Advanced control techniques: hybrid control, nonlinear control, and robust control | CO4 |
| **UNIT5** | Applications of Robotics and Intelligent Systems, Overview of current applications of robotics and intelligent systems, Industrial automation and robotics, Medical robotics and healthcare applications, Service robotics and personal assistants, Autonomous vehicles and drones | CO5 |

**Evaluation:**

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

**Text Books:**


1. Craig, J. J. (2006). *Introduction to robotics*. Pearson Educacion.
2. Albus, S. J., & Meystel, M. A. (2002). *Intelligent Systems*. Wiley.
3. Poole, H. H. (2012). *Fundamentals of robotics engineering*. Springer Science & Business Media.
4. Joseph, L., & Cacace, J. (2018). *Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System*. Packt Publishing Ltd.


**Reference Books**


1. Corke, P. I., & Khatib, O. (2011). *Robotics, vision and control: fundamental algorithms in MATLAB* (Vol. 73, p. 2). Berlin: Springer.
2. John J. Craig, *Introduction to Robotics: Mechanics and Control*, (3e), PHI, 2005.
3. C. Peter., Robotics, Vision and Control: Fundamental Algorithms in MATLAB. Vol. 73. Springer, 2011.
4. G. Ashitava, *Robotics: Fundamental Concepts and Analysis*, Oxford University Press, 2006.
5. Murray, Richard M., Zexiang Li, S. Shankar Sastry, and S. Shankara Sastry, A *Mathematical Introduction to Robotic Manipulation*, CRC press, 1994.


## BCA 703(C) - Distributed System

| | |
|---|---|
| **School** | Birla School of Applied Sciences |
| **Programme** | BSc(DS) |
| **Batch** | 2023-26 |

| | |
|---|---|
| **Branch/Discipline** | BSc(DS) |
| **Semester** | VII |
| **Course Title** | Distributed System |
| **Course Code** | BSc(DS) |
| **Credit** | 4 |
| **Course Type** | CC |
| **Course Objective** | The subject aims to provide the student with:<br>1. Understand the fundamentals of distributed computing, including its history, characteristics, benefits, and architectures.<br>2. Learn the different models and algorithms used in distributed computing, including message-passing and shared-memory models, and distributed consensus algorithms.<br>3. Gain knowledge about the principles of designing and implementing distributed systems, including middleware, security, and performance.<br>4. Develop skills in designing and developing distributed applications using service-oriented architecture, web services, and mobile computing.<br>5. Explore emerging trends and future directions in distributed computing, including edge computing, blockchain, and quantum computing. |
| **Course Outcome (COs)** | After completion of this course students will be able to:<br>CO1. Understand the fundamental concepts of distributed computing, including its history, architecture, and paradigms.<br>CO2. Apply various distributed computing models and algorithms, such as message-passing and shared-memory models, to solve real-world problems.<br>CO3. Design and implement distributed systems that are secure, scalable, and performant, using middleware and infrastructure technologies.<br>CO4. Develop distributed applications using modern frameworks and technologies, such as service-oriented architecture, web services, and mobile computing.<br>CO5. Evaluate and analyse emerging trends and future directions in distributed computing, including block chain, distributed artificial intelligence, and quantum computing, |

**Course Outline**

| Unit | Description | CO Mapping |
|---|---|---|
| **UNIT1** | Introduction to Distributed Computing, Introduction to distributed computing, Evolution and history of distributed computing, Characteristics and benefits of distributed computing, Distributed | CO1 |

| | | |
|---|---|---|
| | systems architecture and models, Distributed computing paradigms | |
| **UNIT2** | 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 |
| **UNIT3** | 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 |
| **UNIT4** | 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 |
| **UNIT5** | 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.

**Reference Book:**

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