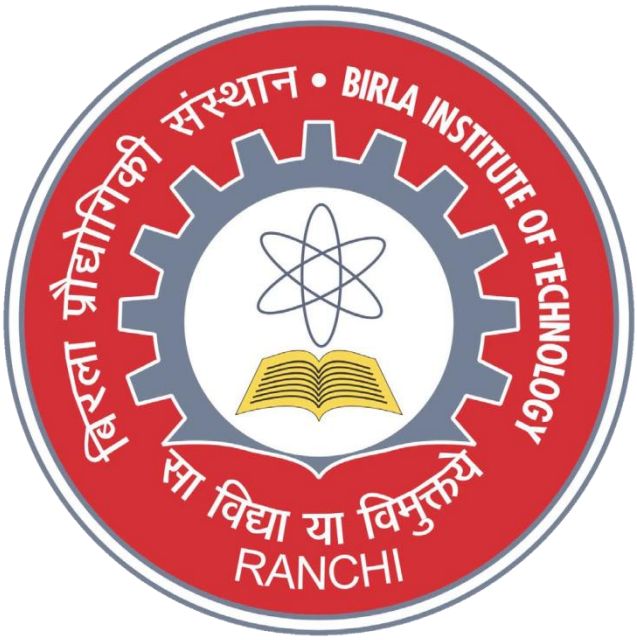
# BIRLA INSTITUTE OF TECHNOLOGY




## BACHELOR IN COMPUTER APPLICATION
## CURRICULUM
## BASED ON NATIONAL EDUCATION POLICY2020
## (Effective from Academic Session: 2025-26)

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**Institute Vision**

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

**Institute Mission**

- To educate students at Under Graduate, Post Graduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

**Department Vision**

The department strives to be recognized globally for outstanding education and research, leading to excellent professionals and innovators in the field of Computer Science and Engineering, who can positively contribute to the society.

**Department Mission**

1. To impart quality education and equip the students with strong foundation that could make them capable of handling challenges of the new century.
2. To maintain state-of-the-art research facilities and facilitate interaction with world's leading universities, industries, and research organization for constant improvement in the quality of education and research.

**Programme Educational Objectives (PEOs)**

**PEO 1:** The program will produce graduates who will be competent professionals in IT industry, academics, government or entrepreneurs.

**PEO2:** Graduates will exhibit professional ethics, critical thinking,problem solving and effective communication skills to work collaboratively in a team-based environment.

**PEO 3:** The graduates will possess leadership qualities and will be capable of attaining higher positions in their professional career.

**PEO4:** Graduates will be able to adapt to the fast-changing world of technology and will become effective professionals to address the technical, social and business challenges.

**PEO 5:** Graduates will recognize the importance of interdisciplinary learning; engage in lifelong learning and professional development.

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

## (A) ProgrammeOutcomes(POs)

Graduates will be able to:

1. **Discipline knowledge:** Demonstrate the comprehensive knowledge of mathematics, computing fundamentals and domain concepts to enhance their professional skills.
2. **Problem analysis:**Apply to identify,formulate and analyze solutions to various computing problems using the fundamental principles of computing.
3. **Design/development of solutions:** Ability to design, develop and implement computer-based solutions to real world problems using appropriate tools and techniques.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modem IT tools including prediction and modeling to challenging problems.
6. **The graduates and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the IT professionals
7. **Environment and sustainability:** Understand the impact of the professional computer-based solutions in societal and environmental contexts,and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles to maintain the integrity in a working environment in sustainable societal development through objective, unbiased and truthful actions.
9. **Individualandteamwork:** Ability to work effectively as an individual,and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Express thoughts and ideas effectively in understanding computing activities by writing effective reports, making effective presentations, constructing documentation and presenting complex information in a concise manner.
11. **Project management:** Learn to build a project from pre-implementation to completion within constraints in multidisciplinary environments.
12. **Life-longlearning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## (B) ProgrammeSpecificOutcomes (PSOs)

1. The ability to analyze, design, code and test application specific or complex problems in Cryptography and Network Security, Design and Analysis of Algorithm, Computer Networks, Cloud Computing, Mobile Computing, Data Mining and Big Data by applying the knowledge of basic sciences, mathematics and fundamentals.
2. The ability to adapt for rapid changes in tools and technology with an understanding of societal and ecological issues relevant to professional practice through life-long learning.
3. Excellent adaptability to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities.

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# PROGRAMME COURSE STRUCTURE

BIRLA INSTUTURE OF TECHNOLOGY -MESRA, RANCHI
COURSE STRUCTURE FOR BACHELOR OF COMPUTER APPLICATION

as per NEP-2020

(w.e.f. Academic Session 2025-26)

| Semester/ Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical | | | Total Credits C |
|---|---|---|---|---|---|---|---|---|
| | | | THEORY | | L | T | P | C |
| First Monsoon | FIRST | Pre-requisite course * | PR25001 | Elementary Mathematics | 3 | 0 | 0 | 0 |
| | | DSC-Elective | | DSC-Elective I | 3 | 0 | 0 | 3 |
| | | DSC-Course | CN25105 | Basics of Operating Systems | 3 | 0 | 0 | 3 |
| | | DSC-Course | CN25107 | Fundamentals of Computer Science | 2 | 0 | 0 | 2 |
| | | MDC | MN25106 | Principles of Management | 3 | 0 | 0 | 3 |
| | | VAC–Elective | | VAC Elective | | - | - | 2 |
| | | VAC–Elective | | VAC Elective | - | - | - | 2 |
| | | LABORATORIES | | | | | | |
| | | AECC | HS24131 | Communication Skills-I | 0 | 0 | 3 | 1.5 |
| | | DSC Lab | | DSC Lab –Elective I | 0 | 0 | 3 | 1.5 |
| | | SEC-SB Elective | | SEC-SB Elective I | - | - | - | 3 |
| | | TOTAL | | | | | | 21 |

*[will be pass course with no credits]

| Semester /Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery & credits L-Lecture; T-Tutorial; P-Practical | | | Total Credits C |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods/ week) | T (Periods /week) | P (Periods /week) | C |
| **Second Spring** | **First** | **THEORY** | | | | | | |
| | | DSC-Course | CN25121 | Introduction to Data Structures | 3 | 1 | 0 | 4 |
| | | DSC-Course | CN25123 | Basics of Digital Computer and Logic Design | 3 | 1 | 0 | 4 |
| | | MDC | CN25131 | Mathematics for Computing I | 3 | 1 | 0 | 4 |
| | | VAC–Elective | | VAC Elective | 2 | 0 | 0 | 2 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **LABORATORIES** | | | | | | |
| | | AECC | HS24133 | Communication Skills-II | 0 | 0 | 3 | 1.5 |
| | | | CN25122 | Data Structure Lab | 0 | 0 | 3 | 1.5 |
| | | SEC-SB Elective | | SEC-SB Elective II | - | - | - | 3 |
| | | **Total** | | | | | | **20** |
| | | **GRAND TOTAL FOR FIRST YEAR** | | | | | | **41** |
| **VOCATIONAL COURSES FOR EXIT AFTER 1st Year** | | | | | | | | |
| Vocational Course I | | MN25120 | Event Management | | 3 | 0 | 0 | 3 |
| Vocational Course II | | CN25131 | Fundamentals of Multimedia | | 3 | 0 | 0 | 3 |

EXIT OPTION WITH CERTIFICATION IN COMPUTER APPLICATIONS

| Semester/ Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L- Lecture; T-Tutorial; P-Practical | | | Total Credits C |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods/ week) | T (Periods/ week) | P (Periods /week) | C |
| **Third Monsoon** | **Second** | **THEORY** | | | | | | |
| | | DSC-Course | CN25201 | Java Programming | 3 | 0 | 0 | 3 |
| | | | CN25203 | Database Management System | 3 | 0 | 0 | 3 |
| | | | CN25205 | Computer Organization & Architecture | 3 | 0 | 0 | 3 |
| | | MDC | CN25207 | Mathematics for Computing II | 3 | 0 | 0 | 3 |
| | | AECC | MN25109 | Public speaking and creative writing | 1 | 0 | 2 | 2 |
| | | SEC-SB | | SEC-SB Elective III | 2 | 0 | 2 | 3 |
| | | **LABORATORIES** | | | | | | |
| | | DSC Lab | CN25202 | Java Lab | 0 | 0 | 3 | 1.5 |
| | | DSC Lab | CN25204 | DBMS Lab | 0 | 0 | 3 | 1.5 |
| | | TOTAL | | | | | | **20** |

| Semester/ Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical | | | Total Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods /week) | T (Periods /week) | P (Periods /week) | C |
| **Fourth Spring** | **Second** | **THEORY** | | | | | | |
| | | DSC-Course | CN25221 | Software Engineering | 3 | 1 | 0 | 4 |
| | | DSC-Course | CN25223 | Python Programming | 3 | 1 | 0 | 4 |
| | | DSC-Course | CN25225 | Computer Networks | 3 | 0 | 0 | 3 |
| | | DSE-Elective | | DSE Elective I | 3 | 0 | 0 | 3 |
| | | AECC | MN25201 | Personality Development | 2 | 0 | 2 | 3 |
| | | MC | HU24211 | Indian Knowledge System | | | | 0 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **LABORATORIES** | | | | | | |
| | | DSC Lab | CN25222 | Software Engineering Lab | 0 | 0 | 3 | 1.5 |
| | | DSC Lab | CN25224 | Python Programming Lab | 0 | 0 | 3 | 1.5 |
| | | | Total | | | | | 20 |
| | | | | **GRAND TOTAL FOR SECOND YEAR** | | | | 40 |

| **VOCATIONAL COURSES FOR EXIT AFTER 2nd Year** | | | | | | |
|---|---|---|---|---|---|---|
| **Vocational Course III** | MN25214 | Basic of Financial Markets and Equity Research | 3 | 0 | 0 | 3 |
| **Vocational Course IV** | CN25225 | Business Intelligence | 3 | 0 | 0 | 3 |

**EXIT OPTION WITH DIPLOMA IN COMPUTER APPLICATIONS**

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| Semester/ Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical | | | Total Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods /week) | T (Periods /week) | P (Periods /week) | C |
| Fifth Monsoon | THIRD | **THEORY** | | | | | | |
| | | DSC-Course | CN25301 | Fundamentals of Computer Algorithm | 3 | 1 | 0 | 4 |
| | | DSE-Elective | | DSE-Elective II | 3 | 0 | 0 | 3 |
| | | DSC-Course | CN25307 | Web Programming | 3 | 1 | 0 | 4 |
| | | DSC-Course | CN25309 | Software Testing | 3 | 1 | 0 | 4 |
| | | **LABORATORIES** | | | | | | |
| | | DSE Lab | | DSE Lab-Elective II | 0 | 0 | 3 | 1.5 |
| | | DSC-Course | CN25308 | Web Programming Lab | 0 | 0 | 3 | 1.5 |
| | | Minor Internship/ Project | CN25312 | Internship/Project | 0 | 0 | 0 | 2 |
| | | **TOTAL** | | | | | | **20** |

| Semester/ Sessionof Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L- Lecture; T-Tutorial; P-Practical | | | Total Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods /week) | T (Periods /week) | P (Periods /week) | C |
| Sixth Spring | Third | **THEORY** | | | | | | |
| | | DSE Elective | | DSE-Elective III | 3 | 1 | 0 | 4 |
| | | DSC-Course | CN25335 | Distributed Computing | 3 | 0 | 0 | 3 |
| | | DSE-Elective | | DSE-Elective IV | 3 | 0 | 0 | 3 |
| | | | CN25341 | Optimization Techniques | 3 | 1 | 0 | 4 |
| | | **LABORATORIES** | | | | | | |
| | | DSE Lab-Elective | | DSE Lab-Elective III | 0 | 0 | 3 | 1.5 |
| | | DSE Lab-Elective | | DSE Lab-Elective IV | 0 | 0 | 3 | 1.5 |
| | | | CN25344 | Minor Project | 0 | 0 | 0 | 3 |
| | | **TOTAL** | | | | | | **20** |
| **GRAND TOTAL FOR THIRD YEAR** | | | | | | | | **40** |

**EXIT OPTION WITH DEGREE (BCA)**
**Total Credits [I Year + II year + III Year = 41 + 40 + 40 = 121**

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**SPECIALIZATION:**

**ArtificialIntelligenceandMachineLearning/DataScience/High Performance Computing**

| Semester/ Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L- Lecture; T-Tutorial; P-Practical | | | Total Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods /week) | T (Periods /week) | P (Periods /week) | C |
| | | **THEORY** | | | | | | |
| **Seventh Monsoon** | **Fourth** | DSE-Elective | | DSE-Elective V Annexure A/Annexure B/ Annexure C | 3 | 1 | 0 | 4 |
| | | DSE-Elective | | DSE-Elective VI Annexure A/Annexure B/ Annexure C | 3 | 1 | 0 | 4 |
| | | DSE-Course | CN407 | Research Methodology | 3 | 1 | 0 | 4 |
| | | DSE-Elective | | DSE-Elective VII Annexure A/Annexure B/ Annexure C | 3 | 1 | 0 | 4 |
| | | **LABORATORIES** | | | | | | |
| | | DSE Lab-Elective | | DSE Lab- Elective V Annexure A/Annexure B/ Annexure C | 0 | 0 | 4 | 2 |
| | | DSE Lab-Elective | | DSE Lab-Elective VI Annexure A/Annexure B/ Annexure C | 0 | 0 | 4 | 2 |
| | | **TOTAL** | | | | | | **20** |

| Semester/ Session of Study (Recommended) | Course Level | Category of Course | Course Code | Courses | Mode of delivery and credits L- Lecture; T-Tutorial; P-Practical | | | Total Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | L (Periods /week) | T (Periods /week) | P (Periods /week) | C |
| | | **THEORY** | | | | | | |
| **Eighth Spring** | **Fourth** | DSE-Elective | | DSE-Elective VIII Annexure A/Annexure B/ Annexure C | 3 | 0 | 0 | 3 |
| | | DSE-Elective | | DSE-Elective IX Annexure A /Annexure B/ Annexure C | 3 | 0 | 0 | 3 |
| | | **LABORATORIES** | | | | | | |
| | | DSE Lab-Elective | | DSE Lab-Elective VIII Annexure A/Annexure B/ Annexure C | 0 | 0 | 4 | 2 |
| | | Research Project/ Dissertation | CN470 | Research project/ Internship with Viva-voce and seminar presentation. | 0 | 0 | 0 | 12 |
| | **TOTAL** | | | | | | | **20** |

**AFTER FOURTH YEAR BACHELOR'S DEGREE:BCA HONOURS**

Total Credits 161 for 4 years course

Student will select the specialization in one of the followings:

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- **Annexure A-Artificial Intelligence and Machine Learning**
- **Annexure B-Data Science**
- **Annexure C-High Performance Computing**

Acronyms Expanded

- AECC : Ability Enhancement Compulsory Course
- DSC : Discipline-Specific Core (Course)
- DSE : Discipline-Specific Elective (Course)
- VAC : ValueAddedCourse
- SEC-SB : Skill Enhancement Course-Skill Based
- MDC : Multidisciplinary Course

## ELECTIVES

| DSC Electives | Course Code | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| DSC-Elective I | CN25101 | Programming and Problem-Solving using C | 3 | 0 | 0 | 3 |
| | CN25103 | Programming and Problem-Solving using C++ | 3 | 0 | 0 | 3 |
| DSC Lab–Elective I | | | | | | |
| | CN25102 | C Lab | 0 | 0 | 3 | 1.5 |
| | CN25104 | C++ Lab | 0 | 0 | 3 | 1.5 |

**VAC Electives**

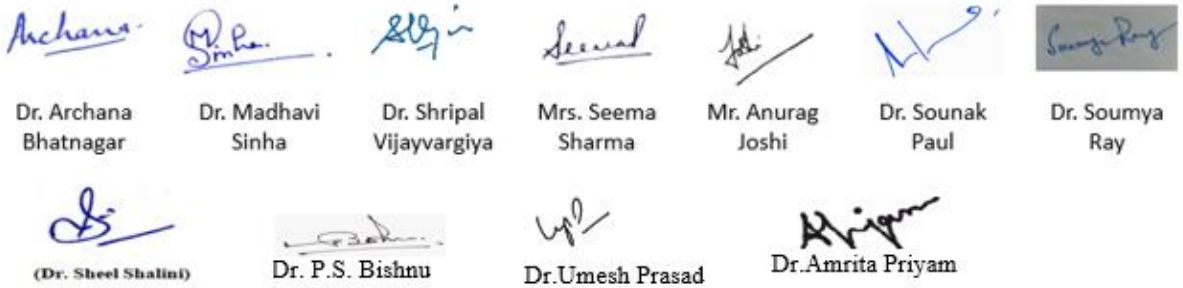
| | CourseCode | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **VAC Elective** | MN25102 | Human Values and Professional Ethics | 2 | 0 | 0 | 2 |
| | CN25109 | Environmental Science | 2 | 0 | 0 | 2 |
| | MN25103 | Yoga | 1 | 0 | 2 | 2 |
| | MN25104 | Physical Education | 1 | 0 | 2 | 2 |
| | MN25111 | Digital Empowerment | 2 | 0 | 0 | 2 |
| | MN25112 | Emotional Intelligence | 2 | 0 | 0 | 2 |

**SEC-SB Electives**

| | Course Code | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| SEC I | CN25110 | Office Automation Tools | 0 | 1 | 4 | 3 |
| | CN25112 | Linux administration | 0 | 1 | 4 | 3 |
| SEC II | CN25130 | Programming with MATLAB | 0 | 1 | 4 | 3 |
| | CN25132 | Introduction to Latex | 0 | 1 | 4 | 3 |
| SEC III | CN25209 | Statistics with R | 2 | 0 | 2 | 3 |
| | CN25115 | Computer Oriented Numerical Methods | 2 | 0 | 2 | 3 |

**DSE Electives**

| | CourseCode | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| DSE-Elective I | CN25227 | Introduction to Data Science | 3 | 0 | 0 | 3 |
| | CN25229 | Introduction to Artificial Intelligence | 3 | 0 | 0 | 3 |
| | CN25231 | Enterprise Resource Planning | 3 | 0 | 0 | 3 |
| DSE-Elective II | CN25303 | Introduction to Machine Learning | 3 | 0 | 0 | 3 |
| | CN25305 | Computer Graphics | 3 | 0 | 0 | 3 |
| DSE Lab-Elective II | CN25304 | Machine Learning Lab | 0 | 0 | 3 | 1.5 |



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| | | | | | | |
|---|---|---|---|---|---|---|
| | CN25306 | Computer Graphics Lab | 0 | 0 | 3 | 1.5 |
| DSE-Elective III | CN25331 | Advanced Java Programming | 3 | 1 | 0 | 4 |
| | CN25333 | Data Analytics | 3 | 1 | 0 | 4 |
| DSE Lab-Elective III | CN25332 | Advanced Java Programming Lab | 0 | 0 | 3 | 1.5 |
| | CN25334 | Data Analytics Lab | 0 | 0 | 3 | 1.5 |
| DSE-Elective IV | CN25337 | Introduction to Data Mining | 3 | 0 | 0 | 3 |
| | CN25339 | Introduction to IOT | 3 | 0 | 0 | 3 |
| DSE Lab-Elective IV | CN25338 | Data Mining Lab | 0 | 0 | 3 | 1.5 |
| | CN25340 | IOT Lab | 0 | 0 | 3 | 1.5 |

**ANNEXURE A: Artificial Intelligence and Machine Learning**

**Courses and Labs to be taken from the following table in 7th and 8th semesters**

| DSE | Course Code | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| DSE-Elective V | CN25401 | Deep Learning | 3 | 1 | 0 | 4 |
| | CN25411 | Data Visualization | 3 | 1 | 0 | 4 |
| DSE Lab-Elective V | CN25402 | Deep Learning Lab | 0 | 0 | 4 | 2 |
| | CN25412 | Data Visualization Lab | 0 | 0 | 4 | 2 |
| DSE-Elective VI | CN25403 | Digital Gaming | 3 | 1 | 0 | 4 |
| | CN25415 | Advanced Python Programming | 3 | 1 | 0 | 4 |
| DSE Lab-Elective VI | CN25404 | Digital Gaming Lab | 0 | 0 | 4 | 2 |
| | CN25416 | Advanced Python Programming Lab | 0 | 0 | 4 | 2 |
| DSE-Elective VII | CN25405 | Soft Computing | 3 | 1 | 0 | 4 |
| | CN25409 | Natural Language Processing | 3 | 1 | 0 | 4 |
| DSE-Elective VIII | CN25413 | Advanced Data Analytics | 3 | 0 | 0 | 3 |
| | CN25421 | Reinforcement Learning | 3 | 0 | 0 | 3 |
| | CN25423 | Feature Engineering | 3 | 0 | 0 | 3 |
| DSE Lab-Elective VIII | CN25414 | Advanced Data Analytics Lab | 0 | 0 | 4 | 2 |
| | CN25422 | Reinforcement Learning Lab | 0 | 0 | 4 | 2 |
| | CN25424 | Feature Engineering Lab | 0 | 0 | 4 | 2 |
| DSE-Elective IX | CN25417 | Computer Vision | 3 | 0 | 0 | 3 |
| | CN25419 | Image Processing | 3 | 0 | 0 | 3 |

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**ANNEXURE B: Data Science**
**Courses and Labs to be taken from following table in 7th and 8th semester**

| DSE Electives | Course Code | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| DSE-Elective V | CN25425 | No SQL Data Base | 3 | 1 | 0 | 4 |
| | CN25431 | Cloud Computing | 3 | 1 | 0 | 4 |
| DSELab- ElectiveV | CN25426 | No SQL Lab | 0 | 0 | 4 | 2 |
| | CN25432 | Cloud Computing Lab | 0 | 0 | 4 | 2 |
| DSE-ElectiveVI | CN25415 | Advanced Python Programming | 3 | 1 | 0 | 4 |
| | CN25433 | Data PrProcessing and Reporting | 3 | 1 | 0 | 4 |
| DSELab-ElectiveVI | CN25416 | Advanced Python Programming Lab | 0 | 0 | 4 | 2 |
| | CN25434 | Data Preprocessing and reporting Lab | 0 | 0 | 4 | 2 |
| DSE-ElectiveVII | CN25405 | Soft Computing | 3 | 1 | 0 | 4 |
| | CN25427 | Data Ethics and Privacy | 3 | 1 | 0 | 4 |
| | CN25429 | Cryptography &Network Security | 3 | 1 | 0 | 4 |
| DSE-ElectiveVIII | CN25413 | Advanced Data Analytics | 3 | 0 | 0 | 3 |
| | CN25437 | Data Security | 3 | 0 | 0 | 3 |
| DSE Lab-Elective VIII | CN25414 | Advanced Data AnalyticsLab | 0 | 0 | 4 | 2 |
| | CN25438 | Data security Lab | 0 | 0 | 4 | 2 |
| DSE-ElectiveIX | CN25435 | Big Data Analytics | 3 | 0 | 0 | 3 |
| | CN25419 | Image Processing | 3 | 0 | 0 | 3 |

**ANNEXURE C: High Performance Computing**
**Courses and Labs to be taken from the following table in the 7th and 8th semester**

| DSE Electives | Course Code | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| DSE-Elective V | CN25441 | Massively Parallel Models of Computation | 3 | 1 | 0 | 4 |
| DSE Lab- Elective V | CN25442 | Massively Parallel Models of Computation Lab | 0 | 0 | 4 | 2 |
| DSE-Elective VI | CN25431 | Cloud Computing | 3 | 1 | 0 | 4 |
| DSE Lab-Elective VI | CN25432 | Cloud Computing Lab | 0 | 0 | 4 | 2 |
| DSE-Elective VII | CN25439 | Advanced Computer Architecture | 3 | 1 | 0 | 4 |
| DSE-Elective VIII | CN25443 | High Performance Cluster Computing | 3 | 0 | 0 | 3 |
| | CN25445 | Grid Computing | 3 | 0 | 0 | 3 |
| | CN25447 | Introduction to Quantum Computing | 3 | 0 | 0 | 3 |
| DSE Lab-ElectiveVIII | CN25444 | Cluster Computing Lab | 0 | 0 | 4 | 2 |
| | CN25446 | Grid Computing Lab | 0 | 0 | 4 | 2 |
| | CN25448 | Quantum Computing Lab | 0 | 0 | 4 | 2 |
| DSE-ElectiveIX | CN25449 | Parallel Algorithm and Computation | 3 | 0 | 0 | 3 |
| | CN25451 | High-Performance Big Data Computing | 3 | 0 | 0 | 3 |

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# SYLLABUS

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**SEMESTER I**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:PR25001**<br>**:ELEMENTARY MATHEMATICS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:0 L:3** | **T:0** | **P:0** |

**Class schedule per week** **:03**
**Class** **:BCA**
**Semester/Level** **:I/1**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand cartesian system, appropriate designing of basic curves. |
| B. | Perform Matrix operations, Linear system and their solutions. |
| C. | Work with simple Finite series and Elementary statistics. |
| D. | Find derivatives of different functions, chain rules and basic understanding of maxima and minima. |
| E. | Solve integral calculus problems ,understand integration rules and definite integrals etc. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Find distance between points, able to draw the basic curves. |
| CO2 | Understand linear system of equations and Gauss elimination method. |
| CO3 | UnderstandTrigonometry and statistics and able to Solve related Problems. |
| CO4 | Find the solutions through differentiations, concept of extreme points and to obtain the functional value on the point. |
| CO5 | Understand how to integrate different algebraic and trigonometric functions. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>**ElementaryGeometry**<br>Point, Location of point, line, Slope of line, Two-point equation, Intercept form of line, Cartesian system, Basic curves-Circle and Parabola. | **8** |
| **Module2 Matrix**<br>Matrix Operation – addition, subtraction, product, Idea of determinant, Inverse ofMatrix, Linear system of equations, solution of linear system, rank of matrix. | **8** |

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| | |
|---|---|
| **Module3**<br>**Series and Statistics**<br>Arithmetic Progression, Geometric Progression, Infinite Geometric Progression, Binomial Expansion.<br>Mean, mode, median, deviation, Standard deviation. | **8** |
| **Module4**<br>**Elementary Differential Calculus**<br>Basics of Functions, Differentiation of functions, Rules of derivatives, addition and subtraction, product rule, Quotient rule, chain rule. Maxima and Minima. | **8** |
| **Module5**<br>**Elementary Integral Calculus**<br>Integration, Rules of integration, integration of constant, Integration of Variable. Integration of Square,Integration of Reciprocal,Integration of Exponentialf unction, Integration of Trigonometric Function, Definite integrals. | **8** |

**TEXT BOOKS:**

1. Thomas George B.,"THOMAS'CALCULUS-earlyTranscendental"Thirteenthedition, Pearson, ISBN 978-0-321-88407-7
2. R.D.Sharma.Mathematics, PartI(Vol. I& II) and Part II(Vol. I&II), Dhanpat Rai Publication.

**REFERENCE BOOKS:**

1. K.C.Sinha.ATextbook of Mathematics, Rastogi Publications;13th Edition:2019-2020.
2. M.N.Mukherjee, P.Mukhopadhyay, S.Sinha Roy and U.Dasgupta .Rudiments of Mathematics, Parul Prakashani Pvt. Ltd.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**Pos met throughTopics beyond syllabus/Advanced topics/Design**

**Course Outcome(CO)Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 |
| CO2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 |
| CO3 | 2 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 | 1 |
| CO4 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 1 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 |

**CorrelationLevels1, 2 or 3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2 |
| CD3 | Seminars | CO3 | CD1,CD2 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self- learning of NPTEL Materials and Internet | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25101**<br>**:PROGRAMMING AND PROBLEM- SOLVING USING C** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:CLab** |
| **Credits:3 L:3** | **T: 0** | **P: 0** |

**Class schedule per week** **: 03**
**Class** **: BCA**
**Semester/Level** **:I/1**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the fundamentals of Cprogramming. |
| B. | Learn about different problems and the approach to solve them. |
| C. | Gain proficiency with the fundamental concepts of the C programming language. |
| D. | Be able to apply these concepts to solve real world problems. |

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| | |
|---|---|
| E. | Able to program in C programming for a given application. |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Choose the loops and decision-making statements to solve the problem. |
| CO2 | Implement different Operations on arrays. |
| CO3 | Use functions to solve the given problem. |
| CO4 | Understand pointers, structures and unions. |
| CO5 | Implement file Operations in C programming for a given application. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Problem Solving and Programming Concepts:** Problem Solving in Everyday Life, Types of Problem, Problem Solving with Computers, General Problem-Solving Strategies.<br>**OverviewofC:** History of C, Importance of C, Structure of C program, Sample of C programs. Constant, Variable and Data types: C Tokens – keywords, identifier, constant, string, and operators, and symbols, Data types – primary data types, user defined data types, and derived data types, Declaration of variables, assign values to variables.<br>**Operators and Expressions:** Different types of operators – arithmetic operators, relational operators, logical operators, assignment operators, increment and decrementoperators,bitwiseoperators,conditionaloperatorsandspecialoperators, Arithmetic expressions –precedence of arithmetic operators, Type conversions in expressions.<br>**Managing input and output operations:** Reading a character, Writing a character, Formatted input, and Formatted output. | **10** |
| **Module2**<br>**Decision making and Branching:** Decision making with if statement - Simple if statement, The if …. else statement, Nesting of if …. else statement, The else if ladder, The switch statement, The ?: Operator, The go-to statement.<br>**Decision making and Looping:** The while statement, The do statement, The for statement, Nesting of loops, Jumps in loops: break, continue. | **8** |
| **Module3**<br>**Arrays:** One - dimensional arrays, Declaration and assign value of one – dimensionalarrays,Two dimensional arrays,Declaration and assign value of two– dimensional arrays, Multi – dimensional arrays.<br>**CharacterArraysandString:** Declaring and initializing string variables,Reading string from terminal, Writing string to screen, Putting string together, Comparison of two strings, String handling functions, Other features of strings. | **7** |
| **Module4**<br>**User defined functions:** A multi – function program, Definition of function, Function calls, Function declaration, Category of functions, Nesting of functions, Recursion, Passing arrays to functions, Passing strings to functions.<br>**StandardLibraryfunction:** math, date and time. | **8** |

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| | |
|---|---|
| **Module5**<br>**Structures and Unions:** Defining a structure, declaring structure variables, Accessing structure members, Arrays of structures, Arrays within structures, Structures within structures, Structures and functions, Union.<br>**Pointers:** Understanding pointers, Accessing the address of a variable, Declaring pointer variables, Pointer expressions, Array of pointers, Pointers to function, Pointers and structures.<br>**File Management:** Defining and opening a file, Closing a file, Input/ Output operations on files, Error handling during I/O operations. | **7** |

**TEXT BOOKS:**


1. BalagurusamyE.,"Programming in ANSIC", 5th Edition, TMH, 2010.
2. SprankleM.,"Problem Solving and Programming Concepts",7thEdition, Pearson Education, New Delhi, 2006.


**REFERENCE BOOKS:**


1. GottfriedB.S.,"Programming with C",Schaum Series, McGraw Hill, 2005.
2. KanetkarY.,"LetusC",4th Edition, BPB publication, NewDelhi, 2002.


**Gaps in the Syllabus (to meet Industry /Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/ Advanced topics/Design**

**POs met through Topics beyond syllabus/ Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

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**CorrelationLevels1, 2or3as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1, CD7, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD9 |
| CD3 | Seminars | CO3 | CD1, CD2, CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1, CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25103**<br>**:PROGRAMMING AND PROBLEM-SOLVING USING C++** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:C++ Lab** |
| **Credits:3 L:3** | **T: 0** | **P: 0** |

**Class schedule per week** **: 03**
**Class** **: BCA**
**Semester/Level** **:I/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the basic concepts of OOP. |
| B. | The course will exemplify the basic syntax and constructs of C++. |
| C. | Understand the application OOP principles in various use cases. |
| D. | Explain basic C++ characteristics and their working. |
| E. | The course aims to expose students to newer C++ constructs. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Identify the difference between procedural and OO programming. |
| CO2 | Construct programs using various OOP principles. |
| CO3 | Design programs using C++. |
| CO4 | Operate on files and strings in real life scenarios. |
| CO5 | Analyze the difference between procedural language and OOP. |

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**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction to Object Oriented Programming:** Basic concept of OOP, Comparison of Procedural Programming and OOP, Benefits of OOP, C++ compilation, Abstraction, Encapsulation, Inheritance, Polymorphism, Difference betweenC and C++.<br>**Elements of C++ Language:** Tokens and identifiers: Character set and symbols, Keywords,C++identifiers;VariablesandConstants:Integer,characterandsymbolic constants; Dynamic initialization of variables, Reference variables, Basic data types in C++, Streams in C++. | **6** |
| **Module2**<br>**Operators and Manipulators:** Operators, Types of operators in C++, Precedence and associativity of operators, Manipulators.<br>**Decision and Control Structures:** if statement, if-else statement, switch statement, Loop: while, do-while, for; Jump statements: break, continue. | **6** |
| **Module3**<br>**Arrays:** One - dimensional arrays, Declaration of one – dimensional arrays, Two – dimensional arrays, Declaration of two – dimensional arrays, Multi – dimensional arrays.<br>**Functions:** Components of function:prototype,function call,definition,parameter; passing arguments; types of function, inline function, function overloading. **Introduction to Classes and Objects:** Classes in C++, class declaration, declaring objects, Defining Member functions, Inline member function,Array of objects,Objects as function argument,Static data member and member function, Friend function and friend class. | **9** |
| **Module4**<br>**Structures and Unions**: Defining a structure, declaring structure variables, Accessing structure members, Arrays of structures, Arrays within structures, Structures within structures, Structures and functions, Union.<br>**Pointers:** Understanding pointers, Accessing the address of a variable, Declaring pointer variables.<br>**Constructors and Destructors:** Constructors, Instantiation of objects, Default constructor, Parameterized constructor, Copy constructor and its use, Destructors, Constraints on constructors and destructors, Dynamic initialization of objects. | **9** |
| **Module5**<br>**Inheritance:** Derived class and base class: Defining a derived class, Accessing the base class member, Inheritance: multilevel, multiple, hierarchical, hybrid; Virtual base class, Abstract class.<br>**Virtual Functions and Polymorphism:** Virtual functions, pure virtual functions; Polymorphism, Categorization of polymorphism techniques: Compile time polymorphism, Run time polymorphism.<br>**FileHandling:** File classes, Opening and Closing a file, File modes, Manipulation of file pointers, Functions for I/O operations. | **10** |

**TEXT BOOKS:**

1. Balagurusamy E, "Object-Oriented Programming with C++", 4th Edition, TMH, 2008.

**REFERENCE BOOKS:**

1. CohoonJ.P.& DavidsonJ.W.,"C++Program Design:An Introduction to Programming and Object-Oriented Design", 2nd Edition, TMH Education, New Delhi, 2000.
2. Friedman F.L. & Koffman E.B.,"Problem Solving, Abstraction, and Design Using C++", 4th Edition, Pearson Education, Inc. 2004.

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**Gaps in the Syllabus (tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advancedtopics/Design:** Template, GUI Design

**Pos met throughTopics beyond syllabus/Advanced topics/Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course Outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping between Cos and Course Delivery(CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/ LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/ Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/ Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTELMaterials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25105**<br>**:Basics of Operating Systems** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week :3**
**Class :BCA**
**Semester/Level : I/1**
**Branch :Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

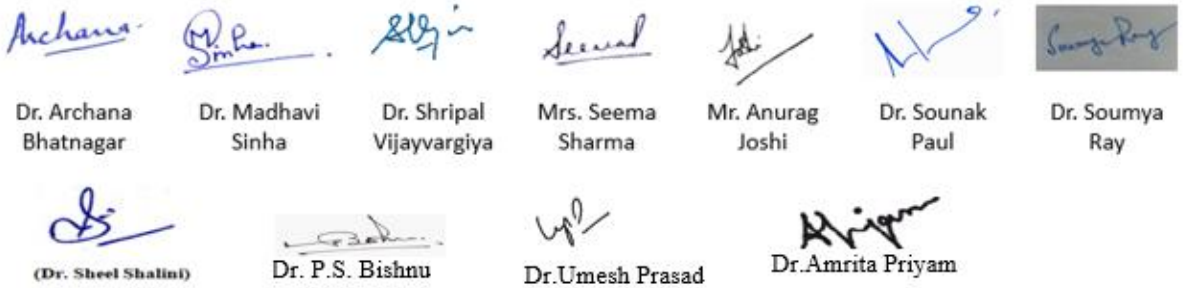
| | |
|---|---|
| A. | Understand the key concepts and principles of operatingsystems. |
| B. | Introduce the concepts of process and thread and their scheduling policies |
| C. | Handle concurrent processes and deadlocks |
| D. | Analyze the different techniques for managing memory and virtual Memory |
| E. | Understand the file organization and I/O and disk scheduling |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Describe the main components of OS and their working |
| CO2 | Explain the core concepts of process management. Analyze and compare different process scheduling algorithms. |
| CO3 | Describe and solve different deadlock issues and solutions |
| CO4 | Compare the different techniques for managing memory and virtual Memory |
| CO5 | Explain the various file organization methods, I/O structure and Disk scheduling. |

**Syllabus**

| **MODULE** | **(No. Of Lecture Hours)** |
|---|---|
| **Module1**<br>Operating system Objective and Functions, Evolution of Operating System, Major Advances in OS Components, Characteristics of Modern Operating Systems, Services | **7** |
| **Module2**<br>Process Concept, Process States, Process Description, Process Control, Threads, Types of Threads.Type of scheduling, Uniprocessor Scheduling, Multiprocessor Scheduling | **7** |
| **Module3**<br>Principle of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery. Combined approaches. | **7** |
| **Module4**<br>Memory Management Requirements, Memory Partitioning, Paging, Segmentation. Virtual Memory, Operating System Policies for Virtual Memory | **7** |
| **Module5**<br>Overview, File Organization and Access, File Directories, File Sharing, Record Blocking, File Allocation. I/O device,Organization of theI/OFunction, Operating System Design Issues,I/O Buffering, Disk Scheduling | **7** |



**TEXT BOOKS:**

1. SilberschatzA.,GalvinP.B.&GagneG.,"OperatingSystemConcepts",10thEdition(or later), Wiley India, 2018

**REFERENCE BOOKS:**

1. D.M. Dhamdhere, Operating Systems:A concept Based Approach",Tata McGraw Hill 2nd Edition
2. Tanenbaum,"Operating Systems Design and Implementation",3rd Edition.,Prentice- Hall Inc., 2006

**Gaps in the Syllabus (to meet Industry/Professionrequirements)**

**POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**Pos met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
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**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and ProgramOutcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 1 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 1 | 1 | 1 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 1 | 2 | 1 | 1 |

**Correlation Levels1, 2or3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between Cos and Course Delivery(CD) methods**

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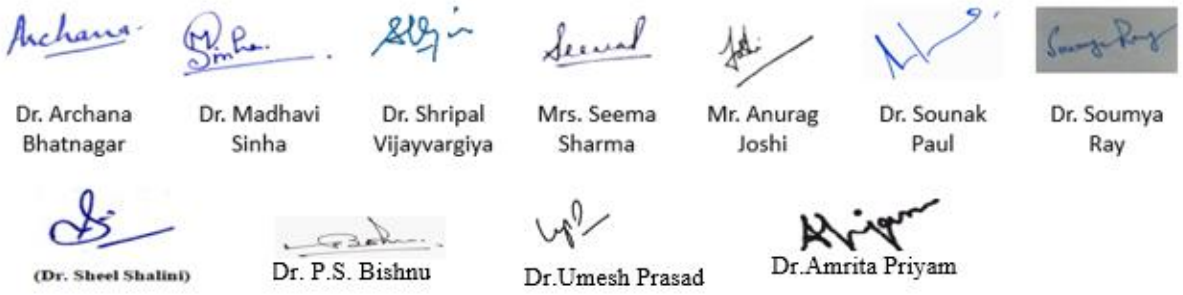
| CD3 | Seminars | CO3 | CD1,CD2,CD5, CD8, CD9 |



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| | | | |
|---|---|---|---|
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD5, CD8, CD9 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2,CD8 |
| CD6 | Industrial/ Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25107**<br>**: FUNDAMENTALS OF COMPUTER SCIENCE** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:2 L:2** | **T:0** | **P:0** |

**Class schedule per week** **: 02**
**Class** **: BCA**
**Semester/Level** **: I/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand working of Computer, software and hardware. |
| B. | Understand basics of operating system and programming languages. |
| C. | Understand number systems and Boolean algebra. |
| D. | Understand different computer devices. |
| E. | Understand the concept of computer memory. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Learn the basics of computer, its software and hardware. |
| CO2 | Describe the concepts of operating system and programming languages. |
| CO3 | Explain number systems and Boolean algebra. |
| CO4 | Describe various input and output devices. |
| CO5 | Describe different memories. |

**Syllabus**

| **MODULE** | **(No. Of Lecture Hours)** |
|---|---|
| **Module1**<br>Introduction to Computers: Definition, Characteristics of Computers, Classification of Computers, Applications of Computers. | **5** |

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| | |
|---|---|
| ComputerSoftware: Software: Definition, Relationship betweenSoftware and Hardware, Software Categories, System Software, Application Software. | |
| **Module2**<br>Operating system: Definition of Operating system, Evolution of operating system, Types of Operating System, Functions of an Operating System, Modern Operating Systems.<br>Computer Program & Languages: Introduction, Developing a program, Algorithm, Flowchart, Pseudo Code (P-Code).Generations of Programming Languages. | **6** |
| **Module3**<br>Number Systems and Logic Gates: Number Systems, Conversion between Number bases, Arithmetic System. Signed and Unsigned Numbers, Concept of Overflow, Binary Coding, Logic Gates, Boolean Algebra and Combination of Logic Gates. | **7** |
| **Module4**<br>Input Devices & Output Devices: Keyboard, Pointing Devices, Digital Camera, Scanners, Optical Scanners, output devices: Printers, Plotters, Monitors, Audio output, Projectors, Terminals. | **5** |
| **Module5**<br>Computer Architecture: Central Processing Unit (CPU), Memory, Communication betweenvariousunitsofaComputerSystem,TheInstructionFormat,InstructionSet, Computer Memory:Primary Memory Hierarchy, Random Access Memory, Types ofRAM,Readonlymemory(ROM),TypesofROM.,Classificationof Secondary Storage Devices, Magnetic Tape, Magnetic Disk, Optical Disk. | **7** |

**TEXT BOOKS:**

1. ITL Education Solution Limited, R & D Wing, Introduction to Computer Science, Pearson Education.
2. ManoM.,"Computer System Architecture",Prentice Hall of India,New Delhi,

**REFERENCE BOOKS:**

1. Raja RamanV, Fundamentals of Computers, Second Edition, PHI,New Delhi.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/ Design**

**Course Outcome(CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels 1, 2, or 3 as defined below:**
1: Slight(Low) 2:Moderate (Medium) 3 :Substantial(High)

**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | Industrial Visits /In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25109**<br>**: ENVIRONMENTAL SCIENCE** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:2 L:2** | **T: 0** | **P: 0** |

**Class schedule per week** **: 02**
**Class** **: BCA**
**Semester/Level** **: I/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Develop basic knowledge of ecological principles and their applications in environment. |
| B. | Identify the structure and composition of the spheres of the earth, the only planet sustaining life. |
| C. | Analyze how the environment is getting contaminated and probable control mechanisms for them. |

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| | |
|---|---|
| D. | Generate awareness and become a sensitive citizen towards the changing environment. |
| E. | Understand and practice various preventive measures of environmental pollution. |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Explain the structure and function of ecosystems and their importance in the holistic environment. |
| CO2 | Identify the sources, causes, impacts and control of air pollution. |
| CO3 | Distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms. |
| CO4 | Judge the importance of soil, causes of contamination and need of solid waste management. |
| CO5 | Predict the sources of radiation hazards and pros and cons of noise pollution. |

**Syllabus**

| MODULE | (No. Of Lecture Hours) |
|---|---|
| **Module1**<br>Ecosystem and Environment: Concepts of Ecology and Environmental Science, ecosystem: structure, function and services, Biogeochemical cycles, energy and nutrient flow, ecosystem management,fate of environmental pollutants, environmental statusand reports on climate change. | **6** |
| **Module2**<br>Air Pollution: Structure and composition of unpolluted atmosphere, classification of air pollution sources, types of air pollutants, effects of air pollution, monitoring of air pollution, control methods and equipment for air pollution control, vehicular emissions and control, indoor air pollution, air pollution episodes and case studies. | **6** |
| **Module3**<br>WaterPollution: WaterResource; Water Pollution:types and Sources of Pollutants; effects of water pollution; Water quality monitoring, various water quality indices, water and waste water treatment: primary, secondary and tertiary treatment, advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal. | **6** |
| **Module4**<br>Soil Pollution and Solid Waste Management: Lithosphere – composition, soil properties, soil pollution, ecological & health effects, Municipal solid waste management – classification of solid wastes, MSW characteristics, collection, storage, transport and disposal methods, sanitary landfills, technologies for processing of MSW: incineration, composing, pyrolysis. | **6** |
| **Module5**<br>Noisepollution&Radioactivepollution:Noisepollution:introduction,sources:Point,line andareasources;outdoorandindoornoisepropagation,Effectsofnoiseonhealth,criteria noise standards and limit values, Noise measurement techniques and analysis, prevention of noise pollution; Radioactive pollution: introduction, sources, classification, health and safety aspects, Hazards associated with nuclear reactors and disposal of spent fuel rods- safe guards from exposure to radiations, international regulation, Management of radioactive wastes. | **6** |

**TEXT BOOKS:**


1. A,K. De.,"Environmental Chemistry", NewAgePublicationsIndiaLtd.,3rdEdition,2008.
2. R.Rajagopalan,"EnvironmentalStudies: From Crisis to Future",3rdEdition,Oxford University Press, 2016.
3. EugeneP.Odum.,"FundamentalsofEcology",3rdEdition, WBSundersCompany,Philadelphia, 1971.


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4. C. N. Sawyer, P. L. McCarty and G. F. Parkin, “Chemistry for Environmental Engineering and Science”, John Henry Press, 2002.
5. S.C.Santra,“EnvironmentalScience”,NewCentralBookAgency, 2011.

**REFERENCE BOOKS:**

1. D.W.Conell,“Basic Concepts of Environmental Chemistry”, CRCPress.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G.,“EnvironmentalEngineering”,Mc-Graw-Hill International.
3. G.M. Masters & Wendell Ela, “Introduction to Environmental Engineering and Science”, PHI Publishers, 1991.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

1. Explain the structure and function of ecosystems and their importance in the holistic environment.
2. Identify the sources, causes, impacts and control of air pollution.
3. Distinguish the various types of water pollution happening in the environmentand understand about their effects and potential control mechanisms.

**POs met through Gaps in theSyllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics /Design-**3, 4,12,13,14

**Course Outcome(CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher’s Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

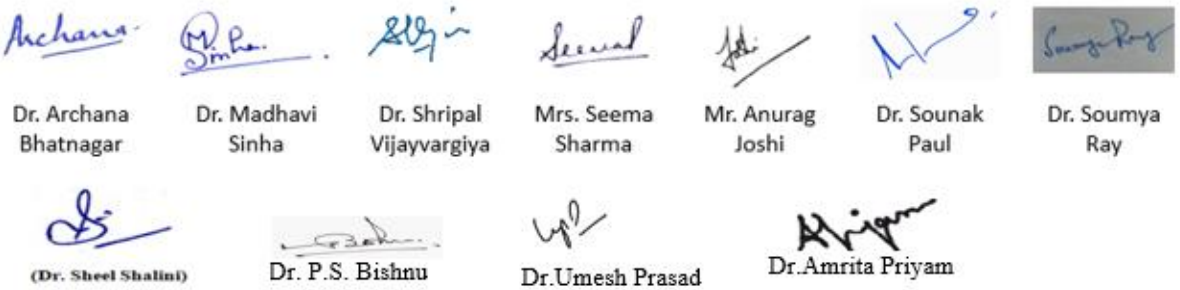
1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | | | | | | | | | | | | | | | |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | | | |
| CO3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | | | |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | | | |
| CO5 | 3 | 3 | 3 | 3 | 1 | | 1 | 1 | | 1 | 1 | 2 | | | |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight(Low) 2:Moderate (Medium) 3:Substantial(High)



**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2 |
| CD3 | Seminars | CO3 | CD1,CD2 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/ Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **: CN25110** |
| **CourseTitle** | | **: OFFICE AUTOMATION TOOLS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:0** | **T:1** | **P:4** |

**Class schedule per week :T(1) P(4)**
**Class : BCA**
**Semester/Level :I/1**
**Branch : Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Use file managers, word processors, spreadsheets, and presentation softwares. |
| B. | Understand the dynamics of an office environment. |
| C. | Present conclusions effectively, orally and in writing. |
| D. | Demonstrate the ability to apply application software in an office environment. |
| E. | To know the practical application of various automation tools. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Use file managers, word processors, spreadsheets, and presentation software. |
| CO2 | Describe the features and functions of the categories of application software. |
| CO3 | Understand the dynamics of an office environment. |
| CO4 | To apply different tools for different automation problems. |
| CO5 | Use Google Suite for office data management tasks. |

**Syllabus**

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| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Basics of Computer**: Introduction of Computer, Computer generations, Types of Computer, Characteristics of Computer, Fundamental understanding of Computer Storage Device, Input Device, Output Device, Types of Software, Usage of Computer. **Windows Operating System:** Introduction to Windows, Starting Windows, Desktop, TaskBar, StartUp Menu, Working with programs and icons-Adding, removing, starting, and quitting programs and icons. Working with files and folders-creating, deleting, opening, finding, copying, moving, and renaming files and folders. Control Panel, setting, My Computer, Recycle bin, My documents, drives. Windows notepad, Accessories, and windows Explorer. | **8** |
| **Module2**<br>**Introduction to OpenOffice/MS Office/LibreOffice**<br>Word Processing: Features, Creating, Saving and Opening Documents in Word, Interface, Toolbars,Ruler, Menus, Keyboard, Shortcut, Editing, Previewing, Printing& Formatting a Document, Advanced Features of MS Word, Find & Replace, Using Thesaurus, UsingAuto-MultipleFunctions,MailMerge, HandlingGraphics, Tables& Charts, Converting a word document into various formats like-Text, Rich Text format, Word perfect, HTML, PDF etc. | **8** |
| **Module 3 Spreadsheets**<br>Worksheet basics, creating worksheet, entering into worksheet, heading information, data, text, dates, alphanumeric values, saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Keyboard shortcuts, Working withsing leand multiple workbook, working with formulae & cell referencing, Auto sum, Coping formulae, Absolute & relative addressing, Worksheet with ranges, formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and Using macros, Multiple worksheets- concepts, creating and using. | **8** |
| **Module4**<br>**Presentation Tools:** Presentation Tools: Adding and formatting text, pictures, graphic objects, including charts, objects, formatting slides, notes, hand-outs, slide shows, using transitions, animations. | **8** |
| **Module5**<br>**OnlineOfficeTool**<br>Google Docs Tools: Creating, saving, downloading, sharing files/folders from Google Drive, creating and sharing Google Docs, importing and exporting Docs, creating and sharing Google Sheets, importing and exporting Google Sheets, Google Forms and form responses, creating Google Slides to present your ideas. | **8** |

**List of Programs as Assignments:**
Implementation of the above modules in the lab experiments.

**TEXT BOOKS:**

1. Computer Fundamentals by Pradeep K Sinha
2. Peter Norton: Computing Fundamentals.6th Edition, McGraw-Hill-Osborne,6 Edition
3. Working in Microsoft Office–Richard Mansfield–Tata McGraw-Hill Education.
4. Microsoft Office 2010 For Dummies By Wallace Wang

**REFERENCE BOOKS:**

1. **https://gsuite.google.com/leaming-center**

**Gaps in the Syllabus(to meet Industry/Profession requirements)**

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1. Introduction to online automation software and applications.
2. Multimedia Introduction.

**POsmetthroughGaps in theSyllabus -**1,2, 3,4

**Topics beyond syllabus/Advanced topics/Design**

1. Online automation, online apps

**POs met through Topics beyond syllabus/Advanced topics/Design-**3, 5, 7, 8

**Course Outcome(CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO3 | 1 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | | 3 |

**Correlation Levels 1, 2, or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping between Cos and Course Delivery (CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture using Boards/LCD Projectors | CO1 | CD1, CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2, CD3, CD8 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2, CD5 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD2, CD4, CD8 |
| CD6 | Industrial/Guest Lectures | | |

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| | | | |
|---|---|---|---|
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning as the use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **Course Code**<br>**Course Title** | | : **CN25112**<br>**: LINUX ADMINISTRATION** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:0** | **T:1** | **P:4** |

**Class scheduleperweek** **:T(1) P(4)**
**Class** **: BCA**
**Semester/Level** **: I/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Explain some of the different distributions of Linux and the reasons for open source. |
| B. | Familiar with Linux commands to manage files and file systems.In-depth knowledge of the structure of the Linux operating system. |
| C. | Learning how to write Shell Scripting with the Linux operating system.Gaining knowledge to configure basic Linux network services. |
| D. | Establish user accounts and permissions. |
| E. | Understand the basics of various OS related concepts, from a programmer's point of view, like files, directories, kernel, inodes, processes, signals, etc. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Know about the Linux Boot Process and System Logging. |
| CO2 | Know about Linux logs and Linux logfiles. |
| CO3 | Know about Disk Management: Creating partitions with fdisk, File Systems. |
| CO4 | Know about LVM-The Logical Volume Manager. |
| CO5 | Know about User Management, ShellScripting, and Networking with the Linux Operating System. |

**Syllabus**

| **MODULES** | **(NO. OF LECTURE HOURS)** |
|---|---|

**List of Programs as Assignments:**
**Implementation of the above modules in the lab experiments.**

1. Install a Linux distribution of your choice on a virtual machine or a spare computer.

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| | |
|---|---|
| **Module1**<br>About Linux Administration, The Linux Boot Process and System Logging, creating Virtual Machine, Installation of Linux Operating System on Virtual Machines, System Login and Linux log files, Viewing and Editing Files, Linux Permissions, File and Directory Permissions. | **6** |
| **Module2**<br>Creating partitions with fdisk, File Systems, LVM - The Logical Volume Manager. Introduction to the Logical Volume Manager (LVM), LVM: Layers of Abstraction Creating Physical Volumes (PVs), Volume Groups (VGs), and Logical Volumes Extending Volume Groups and Logical Volumes Mirroring Logical Volumes, Removing Logical Volumes, Physical Volumes, and Volume Groups Migrating Data from One Storage Device to Another. | **6** |
| **Module3**<br>User Management: Managing Users and Groups, Switching Users, Running Commands, Shell Scripting. | **6** |
| **Module4**<br>Networking: TCP/IP Networking for Linux System Administrators, Networking - DNS and hostnames, DHCP, Dynamic and Static Addressing, TELNET Configuration, FTP, SAMBA Configuration, NFS Configuration, and Network Troubleshooting. | **6** |
| **Module5**<br>Managing Processes and Jobs, Processes and Job Control, Scheduling Jobs with Cron, Managing Software, Installing Software on RPM-Based Linux Distros, Printer Installing Process (CUP) on Linux OS. | **6** |

2. Create a new user account and set a password for it.
3. Change the hostname of the Linux system.
4. Update the system using the package manager.
5. Install a new software package using the package manager.
6. Create a directory called "Documents" in your home directory.
7. Use the command line to navigate to a specific directory.
8. Create a text file using a text editor and save it to your home directory.
9. Use the "ls" command to list the contents of a directory.
10. Use the "cp" command to make a copy of a file.
11. Use the "rm" command to delete a file.
12. Use the "chmod" command to change the permissions of a file or directory.
13. Create a compressed archive of a directory using the "tar" command.
14. Configure a static IP address for the network interface.
15. Set up a basic firewall rule to allow or block incoming connections.
16. Create a symbolic link from one file to another

**TEXT BOOKS:**

1. Linux: The Complete Reference, by Richard Petersen, Sixth Edition, McGraw-Hill.

**REFERENCE BOOKS:**

1. Linux for Beginners: An Introduction to the Linux Operating System and Command Line. E-book
2. Linux Command Line and Shell Scripting Bible by Richard Blum, Christine Bresnahan, 2021

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design.**

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**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| **CO3** | 1 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels 1, 2, or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery (CD)methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2, CD3, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD5 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD2,CD4,CD8 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as the use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode** | | **: CN25102** |
| **CourseTitle** | | **: C LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: Programming and Problem Solving using C** |
| **Credits: 1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **: 3**
**Class** **:BCA**
**Semester/Level** **: II/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the syntax, semantics, and structure of the C programming language and apply them to solve simple problems. |
| B. | Implement decision-making and iterative constructs for problem-solving using control structures. |
| C. | Design and use arrays, strings, and functions to develop modular and reusable code. |
| D. | Apply pointers and structures to manage and manipulate memory and complex data types effectively. |
| E. | UUtilize file handling techniques to perform data storage and retrieval operations, and build real-world applications using C. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Write, compile, and execute basic C programs using variables, data types, and input/output operations. |
| CO2 | Apply conditional and iterative control structures to solve algorithmic problems. |
| CO3 | Implement programs using arrays, strings, and modularize code using functions and recursion. |
| CO4 | Manipulate data efficiently using pointers and structured data types (structures and unions). |
| CO5 | Develop programs that perform file operations and demonstrate the ability to work on real-life problem statements using C. |

**SYLLABUS**

| MODULE | **Number of Lecture hours** |
|---|---|
| **Module 1: Introduction to C Programming**<br>Topics:<br>• Basic syntax, keywords, variables, data types<br>• Input/output using scanf and printf<br>• Arithmetic operations and expression evaluation<br>Programs:<br>1. Input and display student information (name, roll, marks).<br>2. Write a program to compute simple interest. | **4** |

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| | |
|---|---|
| 3. Write a program to perform all arithmetic operations.<br>4. Convert temperature from Celsius to Fahrenheit.<br>5. Swap two numbers using a third variable.<br>6. Swap two numbers without using a third variable. | |
| **Module 2: Control Structures and Looping**<br>Topics:<br>• Conditional statements (if, if-else, switch)<br>• Loops (for, while, do-while)<br>• Nested control structures<br>Programs:<br>7. Check whether a number is even or odd.<br>8. Find the largest of three numbers.<br>9. Check whether a number is prime.<br>10. Generate Fibonacci series up to n terms.<br>11. Find factorial of a number using a loop.<br>12. Write a menu-driven calculator using switch.<br>13. Sum of digits of a number using a loop. | **4** |
| **Module 3: Arrays, Strings, and Functions**<br>Topics:<br>• One-D and Two-D arrays<br>• String manipulation using string.h<br>• User-defined functions and recursion<br>Programs:<br>14. Read and display an array of n integers.<br>15. Find the largest and smallest element in an array.<br>16. Matrix addition and subtraction.<br>17. Check whether a string is a palindrome.<br>18. Count the number of vowels in a string.<br>19. Find the length of a string without using strlen().<br>20. Find GCD of two numbers using recursion. | **4** |
| **Module 4: Pointers and Structures**<br>Topics:<br>• Pointers and pointer arithmetic<br>• Structures, arrays of structures, pointers to structures<br>Programs:<br>21. Demonstrate pointer arithmetic operations.<br>22. Swap two numbers using pointers.<br>23. Access array elements using pointers.<br>24. Create a structure to store student records (name, roll, marks).<br>25. Store and display an array of structures (e.g., employees).<br>26. Pointer to structure: display structure contents using pointer.<br>27. Dynamic memory allocation. | **4** |
| **Module 5: File Handling**<br>Topics:<br>• File operations: fopen(), fclose(), fread(), fwrite(), fprintf(), fscanf()<br>Programs:<br>28. Create and write data to a text file.<br>29. Read and display contents of a file.<br>30. Count the number of characters, words, and lines in a file | **4** |

**TEXT BOOKS:**

1. Jery R Hanly,"ProblemsolvingandProgramdesigninC",PearsonEducation,7thEdition.

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2. Byron Gottfried,“Schaum'sOutlineofProgrammingwithC”,McGraw-Hill.

**REFERENCE BOOKS:**


1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall India Learning Private Limited.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. R. G. Dromey, How to Solve it by Computer, Pearson Education.


**Gaps in the Syllabus (to meet Industry/Profession requirements)**
**POs me through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourseOutcome

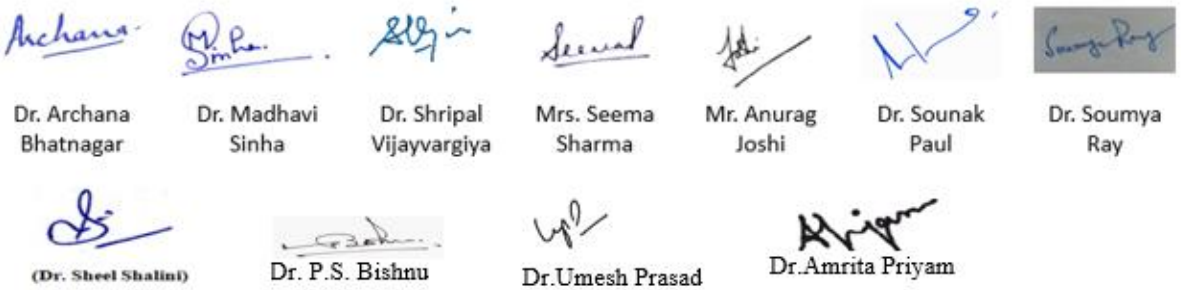
**Mapping between COs and Program Outcomes**

| Courseoutcome | ProgramOutcomes(POs) | | | | | | | | | | | | ProgramSpecific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 2 |
| CO2 | 3 | 2 | 1 | 1 | 2 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | 3 | 2 |
| CO3 | 2 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| CO5 | 2 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels1, 2 or 3as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | Course Delivery Methods | CourseOutcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |



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| | | | |
|---|---|---|---|
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD5, CD8,CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25104** |
| **CourseTitle** | | **:C++ LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **Programmingandproblem-solvingusingC++** |
| **Credits: 1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:I/1**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Learn computer language. |
| B. | Learn coding for problems. |
| C. | Learn the problem-solving process through computer. |
| D. | Know the limitations of system during program execution. |
| E. | Know the practical application of various programming techniques. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Formulate simple algorithms for arithmetic and logical problems. |
| CO2 | Translate the algorithms to programs. |
| CO3 | Test and execute the programs and correct syntax and logical errors. |
| CO4 | Apply programming to solve simple numerical method problems, differentiation of function and simple integration. |
| CO5 | Decompose a problem into functions and synthesize a complete programusing divide and conquer approach. |

**SYLLABUS**

**List of Programs as Assignments:**

1. Write a program to read two numbers from the keyboard and display the larger value on the screen.

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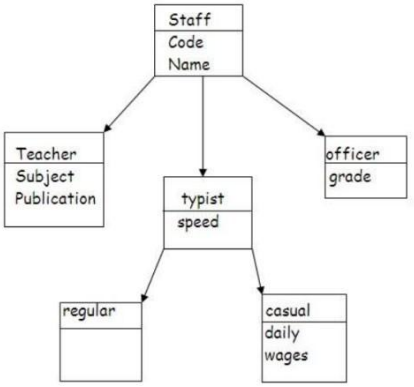
2. Write a program to read two numbers from the keyboard and display the larger value on the screen
3. Write a program to read the values a, b and c and display x, where x=a/b –c.
4. Write a function using reference variables as arguments to swap the values of a pair of integers.
5. Writeaprogramtoevaluatethefollowinginvestmentequation$V=P(1+r)^n$
6. A cricket has the following table of batting figure for a series of test matches: Player's name, Run,Innings,Timenotout."Sachin""8430","230","18";"Saurav""4200","130","9";"Rahul", "3350","105", "11"; Write a program to read the figures,set out in the above forms, to calculate the batting averages and to print out thecomplete table including the averages.
7. An electricity board charges the following rates to domestic users to discourage large consumption of energy: For the first 100 units – 60P per unit For the first 200 units – 80P per unit For the first 300 units – 90P per unit All users are charged a minimum of Rs. 50.00. If the total amount is more than Rs. 300.00 then an additional surcharge of 15% is added. Write a program to read the names of users and number of units consumed and print out the charges with names
8. Write a program to read a matrix of size m*n from the keyboard and display the same on the screen using function.
9. Write a function power() to raise a number m to power n.Thefunction takes a double value for m and int value for n and returns the result correctly. Use a default value of 2 for n to make the functiontocalculatethesquareswhenthisargumentisomitted.Writeamainthatgetsthevaluesof m and n from the user to test the function.
10. Create two classes DM and DB which store the value of distances.DM stores distances in meters and centimeters and DB in feet and inches.Write a program that can read values for the class objects and add one object of DMwith another object of DB.Use a friend function to carry out the addition operation. The object that stores the results may be a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.
11. Wite a function to obtain maximum among three numbers.
12. Assume that a bank maintains two kinds of accounts for customers, one called as savings and the other as current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level a service charge is imposed. Create a class account that stores customer name, account number and type of account. From this derive the classes cur_acct and sav_acct to make them more specific to their requirements. Include necessary member functions in order to achieve the following tasks:(a)Acceptthedepositfromacustomerandupdatethebalance.(b) Display the balance.(c) Compute and deposit interest. (d) Permit withdrawal and update the balance .(e) Check for the minimum balance, impose penalty, necessary and update the balance. Do not use any constructors. Use member functions to initialize class member.
13. An educational institution wishes to maintain a database of its employees. The database is divided into a number of classes whose hierarchical relationships are shown in following figure. The figure also shows the minimum information required for each class. Specify all classes and define functions to create the database and retrieve individual information as and when required.

i.

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14. The database created in exercise19 does not include educational information of the staff.Ithas been decided to add this information to teachers and officers (and not for typists) which will help management in decision making with regard to training, promotions etc. Add another data class called education that holds two pieces of educational information namely highest qualification in general education and highest professional qualification. This class should be inherited by the classes teacher and officer. Modify the program of exercise 19 to incorporate these additions
15. Create a base class called shape.Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the baseshape.Add to the base class, a member function get_data() to initialize baseclass data members and another member function display_area() to compute and display the area of figures. Make display_area() as a virtual function and redefine this function in the derived classes to suit their requirements
16. Write a program to read a list containing item name, item code, and cost interactively and produce a three column output as shown below.
    a. Name Code Cost
    b. TurboC++ 1001 250.95
    c. C primer 905 95.70
17. Modify the above program (Q.16) to fill the unused spaces with hyphens.

**TEXT BOOKS:**

1. Balagurusamy E.,"Object-Oriented Programming with C++",8th Edition, TMH,2020.

**REFERENCE BOOKS:**

1. CohoonJ.P.& Davidson J.W.,"C++ Program Design: An Introduction to Programming and Object-Oriented Design", 3rd Edition, TMH Education, New Delhi, 2002.
2. Friedman F.L. & Koffman E.B., "Problem Solving, Abstraction, and Design Using C++", 4th Edition, Pearson Education, Inc. 2004.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advancedtopics/Design**

**POs met throughTopics beyond syllabus/ Advanced topics/Design**

**Course Outcome(CO) Attainment Assessment Tools & Evaluation Procedure**

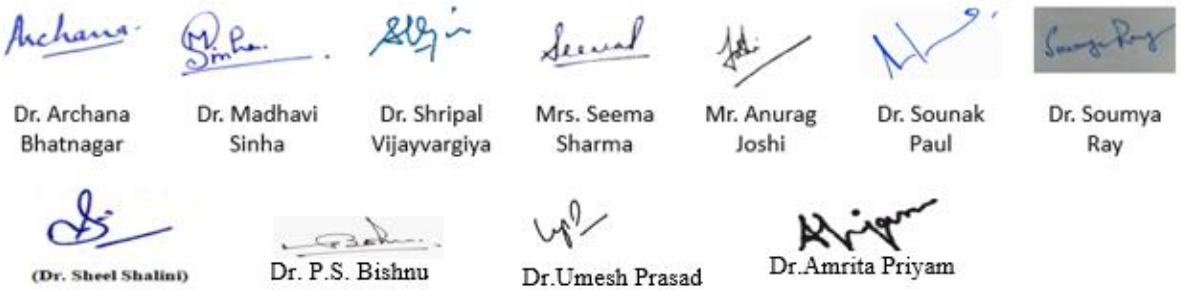
**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Day to day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**



| Course Outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25131**<br>**:Fundamentals of Multimedia** |
| **Pre-requisite(s)** | | **: None** |
| **Co-requisite(s)** | | **:None** |
| **Credits:3 L:3** | **T:0** | **P:3** |

**Classscheduleperweek :3**
**Class :BCA**
**Semester/Level : 1**
**Branch :Bachelor of Computer Applications**

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Define and explain key concepts, types, and applications of multimedia. |
| CO2 | Describe multimedia elements like text, images, audio, video, and animation and their working principles. |

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| | |
|---|---|
| CO3 | Identify multimedia tools and hardware components used in system design and authoring. |
| CO4 | Explain multimedia file formats and apply compression techniques. |
| CO5 | Analyze multimedia applications in real-life scenarios and suggest basic project solutions. |

**Syllabus**

| MODULE | (No. Of Lecture Hours) |
|---|---|
| **Module 1: Introduction to Multimedia**<br>Definition and types of multimedia, Multimedia vs traditional media, Components of multimedia, Applications: Education, Entertainment, Advertising, Virtual Reality,Web | **6** |
| **Module2: Multimedia Elements**<br>Text: Fonts, Unicode, text compression, Image: Bitmap and vector graphics, color models (RGB, CMYK), Audio: Sampling, MIDI, digital audio, audio file formats, Video: Frame rate, resolution, standards (PAL, NTSC), video file formats, Animation: Types, techniques, and principles of animation | **6** |
| **Module3: Multimedia Hardware and Software**<br>Input and output devices: Scanners, cameras, microphones, speakers, Storage devices: CD/DVD, SSD, Flash, Display devices: Monitors, projectors, Authoring tools: Types (Icon-based, Timeline-based), | **7** |
| **Module4: Compression and File Formats**<br>Need for compression, Lossless vs Lossy compression, Image compression (JPEG, PNG), Audio (MP3, WAV), Video (MPEG, AVI), Codecs and containers, Multimedia file standards and compatibility, | **7** |
| **Module5: Multimedia Systems and Applications**<br>Multimedia communication systems, Multimedia in web design, Multimedia databases and streaming, Case studies: e-learning platforms, gaming, social media, Ethical and legal issues in multimedia. | **7** |

**TEXT BOOKS:**
1. 'O' LEVEL Introduction to Multimedia by R.K. Jain [Khanna Publishing House]
2. Introduction to Multimedia (O2.R0) by Satish Jain [BPB Publication]

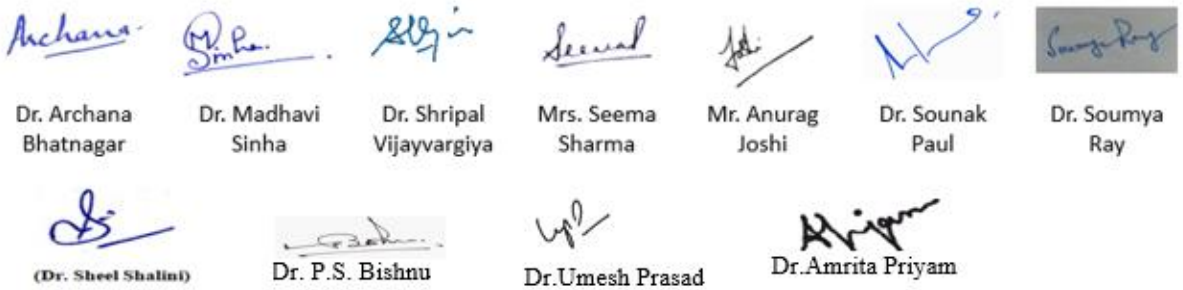
**REFERENCE BOOKS:**
1. Adobe Photoshop Classroom in a Book by Conrad Chavez
2. Adobe Premiere Pro Classroom in a Book by Maxim Jago

**Gaps in the Syllabus (to meet Industry/Professionrequirements)**

**POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**



**Course Outcome(CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

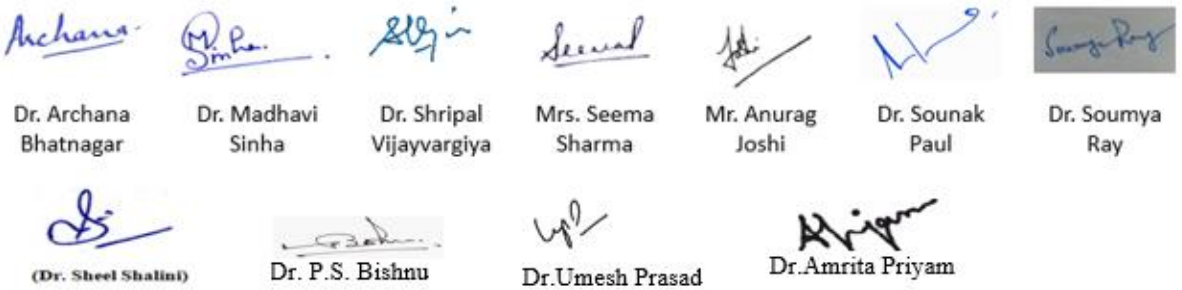
**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 3 | 2 |
| **CO5** | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 |

**Correlation Levels 1, 2, or 3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1, CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2 |
| CD3 | Seminars | CO3 | CD1, CD2 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |



**SEMESTER II**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25121**<br>**:INTRODUCTION TO DATA STRUCTURES** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:DataStructuresLab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **: 04**
**Class** **: BCA**
**Semester/Level** **:II/1**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Know the details about the data structure. |
| B. | Applications, advantages and limitations of various data structures. |
| C. | Real life use of various data structures. |
| D. | Implementations of various data structures. |
| E. | Analyze and compare the different algorithms. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Analyze and compare the efficiency of algorithms and understand the properties of various data structures. |
| CO2 | Apply data structures in the modeling of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design. |
| CO3 | Demonstrate the usage of optimal trees. |
| CO4 | Identifying one of many sorting and searching algorithms and implementing the same for real-life applications. |
| CO5 | Develop solutions for real-life problems using graph-based algorithms. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>**Introduction:** Introduction to Algorithmic, Asymptotic notations, Complexity- Time- Space Trade off. Data Structure-Definition and Classification.<br>**Arrays:** Representation of Arrays in Memory: Accessing of elements of an array, performing operations like Insertion, Deletion, arranging elements, and searching, applications of arrays.<br>**Stacks and Queues**: Introduction to data structures like Stacks and Queues. Operations onStacksandQueues, Array representation of Stacks, Applications of Stacks: Operations of Queues, Representations of Queues, Applications of Queues. | **10** |

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| | |
|---|---|
| **Module2**<br>**Linked Lists**: Singly linked lists, Representation of linked list, Operations of Linked list suchasTraversing, Insertion Deletion, Searching, ApplicationsofLinkedList. | **10** |
| Concepts of Circular linked list and doubly linked list and their Applications, Stacks and Queues as linked lists. | |
| **Module3**<br>**Trees:** Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching, Insertion and Deletion, Applications of Binary search Trees, Complete Binary trees, AVL trees, Threaded Binary trees, m-way search trees, B-Trees. | **8** |
| **Module4:**<br>**Searching and Sorting**: Definition. Linear Search, Binary search, Interpolation Search, TransposeSequentialSearch.InsertionSort, Selection sort,Quick sort,Merge sort, Heap sort. | **6** |
| **Module5**<br>**Graphs:** Terminology and Representations, Adjacency Matrix and Adjacency List Representation, Directed Graphs and Undirected Graphs and their Transversal – DFS & BFS. | **6** |

**TEXTBOOKS:**


1. Horowitz and Sahni,"Fundamentals of Data Structures", Galgotia Publications.
2. Pai G A V, "Data Structures and Algorithms: Concepts, Techniques and Applications", Tata McGraw-Hill.


**REFERENCE BOOKS:**


1. Tannenbaum, "Data Structures", PHI.
2. LipschutzSeymour, "Data Structures", Tata McGraw-Hill.
3. DrozdekAdam, "Data Structures and Algorithms in C++", Thomson Learning.
4. R.L.Kruse, B.P.Leary, C.L.Tondo, "Data Structure and Program Design in C", PHI,
5. MichaelT.Goodrich, "Data Structures and Algorithms in C++", Wiley India Edition.
6. Tremblay J. P., Sorenson P. G, "An Introduction to Data Structures with Applications", McGraw-Hill.


**Gaps in the Syllabus (to meet industry/professional requirements)**

**POs met through Gaps in the Syllabus:**

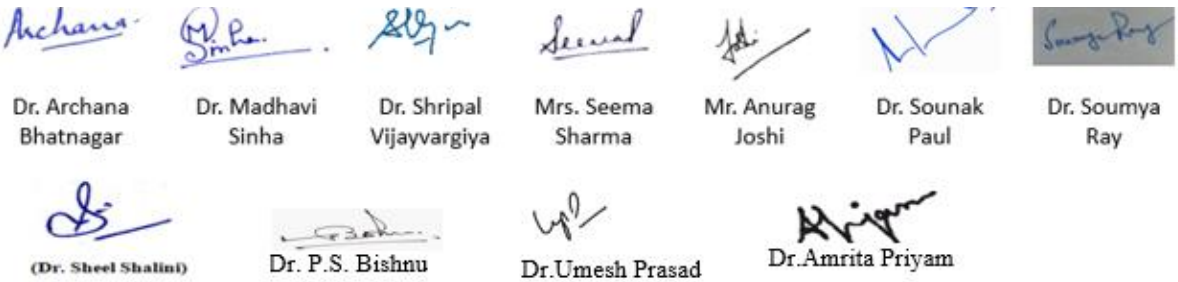
**Topics beyond syllabus/Advanced topics/Design:**

**POs met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome(CO)Attainment Assessment Tools &Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |



**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial(High)

**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | : **CN25123** |
| **CourseTitle** | | **:BASICS OF DIGITAL COMPUTER AND LOGIC DESIGN** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **:04**
**Class** **: BCA**
**Semester/Level** **: II/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**

This course enables the students to:

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

| | |
|---|---|
| A. | Understand basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems. |
| B. | Identify the number of variables and their simplification, importance and understand different circuits for the implementation of Boolean equations. |
| C | Understand common forms of number representation in digital electronic circuits and to be able to convert between different representations. |
| D. | Implement and design simple logical operations using combinational logic circuits and sequential logic circuits. |
| E. | Implement synchronous statemachines using flip-flops. |

**Course Outcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Manipulate numeric information in different forms. |
| CO2 | Manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions. |
| CO3 | Minimize the circuit diagrams by use of K-Map concepts and Boolean Algebra. |
| CO4 | Design and analyze the outcome of the circuit designed. |
| CO5 | Design and analyze sequential circuits and to use standard sequential functions to build larger more complex circuits. |

**Syllabus**

| **Module** | **(No. Of Lecture Hours)** |
|---|---|
| **Module1**<br>**Number System and Boolean Algebra**: Digital Systems, Binary Numbers,Number Base Conversion Methods, Complements of Numbers, Signed Binary Numbers, Binary Codes, Binary Coded Decimal Code, Gray Codes, ASCII Character Code, Error Detecting Codes. Boolean Algebra, Axiomatic Definition of Boolean Algebra, Basic theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Digital Logic Gates, Properties of XOR Gates, Universal Gates. | **10** |
| **Module2**<br>**Minimization Techniques**:Introduction, The minimization with theorems,The Karnaugh Map Method, Three, Four and Five variable K-Maps, Prime and Essential Implications, Product of Sums Simplification, Don't Care Conditions, NAND and NOR Implementation, Multilevel NAND/ NOR realizations. | **10** |
| **Module3**<br>**Combinational Circuits**: Design Procedure – Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Binary Adder, Parallel binary subtractor, Binary Multiplier, Multiplexers/ De-Multiplexers, decoder, Encoder, Code Converters, Magnitude Comparator. | **10** |

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| | |
|---|---|
| **Module4**<br>**Sequential Circuits**: Introduction, Basic Architectural Distinctions between Combinational and Sequential circuits, Latches, The S-R-Latch Flip-Flop The D-Latch, Flip-Flops, SR, JK, D, T and Master slave, characteristic Tables and equations, Conversion from one type of Flip-Flop to another, Analysis of clocked sequential circuits, Register and Counters:Registers, Shift Register, Ripple Counter, Synchronous Counters. | **10** |
| **Module5**<br>**Memory Devices**: Classification of memories – ROM: ROM organization, PROM, EPROM, EEPROM, RAM: RAM organization, Write operation, Read operation, Static RAM, Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic, Implementation of Combinational Logic circuits using ROM, PLA, PAL. | **10** |

**TEXTBOOKS:**

1. Digital Design-Morris Mano, PHI, 3rd Edition.

**REFERENCE BOOKS:**

1. Computer System Architecture-Morris Mano, PHI, 3rd Edition
2. Switching Theory and Logic Design-A. Anand Kumar, PHI, 2nd Edition.
3. Fundamentals of Logic Design-CharlesH.Roth, Cengage Learning, 5th, Edition,2004

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome(CO)Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CO4CD1,CD2 |
| CD5 | Laboratory Experiments/TeachingAids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as the use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25131**<br>**:MATHEMATICS FOR COMPUTING I** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P: 0** |

**Class schedule per week** **:04**
**Class** **: BCA**
**Semester/Level** **: II/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Use appropriate set, function, or relation models to analyse practical examples, interpret the associated operations and terminology in context. |
| B. | Meaning and application of Counting Problems and their uses. |
| C. | Use Pictorial Representation (Graphs) to model Problems and find solutions. |
| D. | Understand the Abstract structure of mathematics, which helps students understand Modular Mathematics, algebra, Cryptography, etc. |
| E. | Solving Problems Using Mathematical Methods. |

**Course Outcomes**
After the completion of this course, students will be able to:

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| | |
|---|---|
| CO1 | Familiar with different terminologies used in Mathematics and Computing. |
| CO2 | Understand and Formulate the Problem. |
| CO3 | Understand Mathematics and its ways for solving a Problem. |
| CO4 | Analyze to solve the Problem using Mathematical Methods. |
| CO5 | Solve the Problems by applying Methods. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module 1**<br>**Sets and Functions**<br>Set, Subset, Set Operations, Properties of Set operations, Functions, properties of Functions, Composite of functions, Inverse of Function.Trigonometric Functions, Exponential and Log function, Greatest Integer and least Integer function. | **10** |
| **Module2 Relations**<br>RelationsonaSet,Propertiesofrelations,ClosuresofRelation,EquivalenceRelation, Partial ordered Relation, Hasse Diagram, Effect of Relations of the Set. | **10** |
| **Module3**<br>**Counting and Recurrence relation**<br>Basics of Counting, Permutation, Combination, Pigeonhole Principle, Solving Recurrence relation using Backtracking and Characteristic equation roots Method. | **10** |
| **Module4 GraphTheory**<br>Terminology of Graphs, Basic Theorems, Digraphs, Path and Cycles, Trees, Connected and Disconnected Graph, Complete Graph, Euler and HamiltonianGraph, Spanning tree and Minimal Spanning Tree for weighted Graph. | **10** |
| **Module5**<br>**AlgebraicStructure**<br>Semi-Group, Monoid, Group, Sub-Group,Ring and Field. | **10** |

**TEXTBOOKS:**


1. Kolman,B.; Busby,R.andRoss, Discrete Mathematical Structures (6e), Pearson Education India –ISBN 978-9332549593.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Applications,PHI, ISBN-978-8120301450


**REFERENCEBOOKS:**


1. RosenKennethH.,"DiscreteMathematicsanditsApplications",6thedition,McGraw-Hill, ISBN 978-0-07-288008-3.
2. Lipschutz Semyour &LipsonMarc,"Discrete Mathematics", McGraw-Hill, 3rd Special Indian Edition, ISBN-13: 978-0-07-060174-1.


**Gaps in the Syllabus(tomeetIndustry/Professionrequirements)**

**Pos met through the Gaps in the Syllabus**

**Topics beyond syllabus/ Advanced topics/ Design**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**POs met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome(CO)Attainment AssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 |
| CO2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 |
| CO3 | 2 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 | 1 |
| CO4 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 1 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | |
| CD2 | Tutorials/Assignments | CO2 | |
| CD3 | Seminars | CO3 | |
| CD4 | Mini Projects/Projects | CO4 | |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | |
| CD6 | Industrial/GuestLectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CA25130**<br>: **Programming with MATLAB** |
| **Pre-requisite(s)** | | : Basic knowledge of programming concepts and fundamental mathematics, including matrices and functions. |
| **Co-requisite(s)** | | : Concurrent enrollment in courses involving numerical methods or applied mathematics is recommended |
| **Credits:3 L:0** | **T:1** | **P:4** |

**Classs chedule per week** **T(1) P(4)**
**Class** **: BCA**
**Semester/Level** **: II/I**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | To introduce students to the MATLAB environment, command window operations, and script file creation. |
| B. | To enable understanding and manipulation of arrays, matrices, and mathematical functions. |
| C. | To develop skills in data visualization using 2D and 3D plotting tools in MATLAB. |
| D. | To equip students with programming constructs like conditional statements and loops in MATLAB. |
| E. | To apply MATLAB for solving algebraic equations, ordinary differential equations, and basic numerical techniques. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand and navigate the MATLAB interface, including command operations and variable management. |
| CO2 | Perform matrix operations and apply built-in mathematical functions for computation. |
| CO3 | Create and customize 2D and 3D plots for data visualization and interpretation. |
| CO4 | Write MATLAB programs using control structures and user-defined scripts. |
| CO5 | Solve algebraic and differential equations using numerical methods within MATLAB. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>Introduction to MATLAB: Starting MATLAB, working in command window, arithmetic operations, display formats, elementary maths built in functions, defining scalar variables, useful command for managing variables, script files | **6** |

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| | |
|---|---|
| **Module2**<br>Basic mathematical operations with arrays : 1 and 2 dimensional arrays, addition and subtraction, array multiplication and division, element-by-element operations, generation of random numbers, analyzing arrays using built-in maths functions | **6** |
| **Module3**<br>Graphics with MATLAB: Basic plot commands: plot, fplot, formatting a plot, subplots, basic 2D and 3D plots: Line plots, mesh and surface plots, contour, View command | **6** |
| **Module4**<br>Programming in MATLAB : Conditional statements, loops, nested loops, application of break and continue commands | **6** |
| **Module5**<br>Mathematical computing with MATLAB: Algebraic equations: Eigen values, Eigen vectors, solution of a system of linear equations.<br>Introduction to ordinary differential equations (ODE), solution of first order ODE, numerical techniques: Trapezoidal rule, Simpson's rule. | **6** |

**Implementation of the above modules in the lab experiments.**

**List of Programs as Assignments**

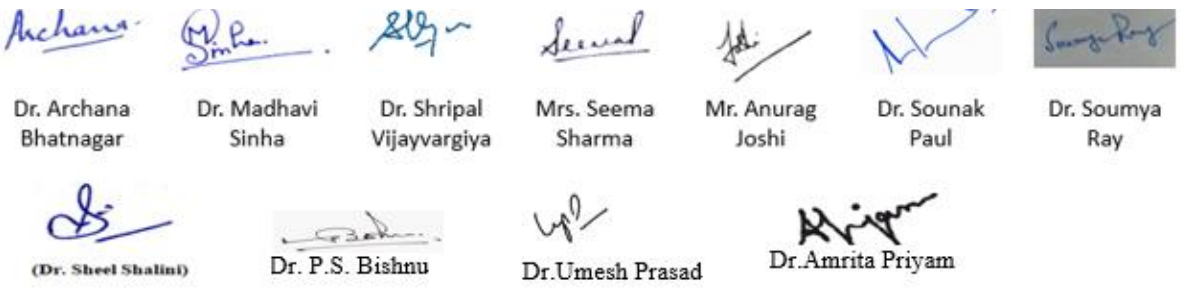
1. To understand the MATLAB Workspace a) start up MATLAB b) type commands in main window c) change current directory
2. To use MATLAB as a calculator: a) perform some arithmetic calculations b) understand the importance of operators, and functions c) use MATLAB's help files d) use functions like sin x , cos x , or |x | to solve problems
3. To understand the purpose of variables and how to create variables.
4. To write a script M-File (a list of MATLAB commands, saved in a file) with an emphasis on using appropriate comments
5. To learn how to create 1 and 2-D arrays, understand the advantages of the different ways of creating arrays, including the standard format and the linspace command.
6. To access specific numbers in arrays using their position.
7. To use array commands to perform different arithmetic operations on arrays
8. To generate of random numbers
9. To perform exercises on using basic commands to plot 2D and 3D plots as mentioned above.
10. To learn different ways of formatting the plots using basic commands like xlabel, ylabel, axis, etc.
11. To learn how to have multiple graphs on the same figure using hold on/off commands
12. To create subplots and application of view command
13. To write simple programs involving loops using commands like for, while, if-else, return, etc.
14. To evaluate Eigen values and Eigen vectors of a given matrix
15. To solve a system of linear equations using Gauss elimination method and Gauss Seidel method
16. To solve a first-orderODE by Euler's method and Runge-Kutta method
17. To evaluate numerical integration by using Trapezoidal and Simpson's rule.

**TEXTBOOKS:**


1. . RudraPratap,*Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers*, Oxford University Press, 2010.
2. Amos Gilat, *MATLAB: An Introduction with Applications*, Wiley India


**REFERENCE BOOKS:**


1. A Guide to MATLAB - for Beginners and Experienced Users", 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, 2006.
2. Wolfram S., The Mathematica, Cambridge University Press, 2003.
3. Steven C. Chapra, *Applied Numerical Methods with MATLAB for Engineers and Scientists*, McGraw-Hill.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

**POs met through Gaps in the Syllabus**

**Topics beyond syllabus/ Advanced topics/Design**

**Pos met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome(CO) Attainment AssessmentTools&EvaluationProcedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO3 | 1 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery(CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
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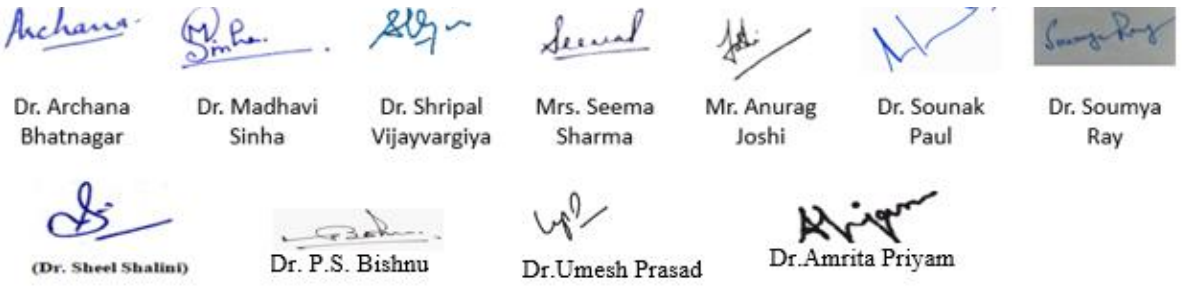
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2, CD5 |



| | | | |
|---|---|---|---|
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD2, CD4, CD8 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | | |
|---|---|---|---|
| **CourseCode** | | | : **CN25132** |
| **CourseTitle** | | | **: LateX Lab** |
| **Pre-requisite(s)** | | | **:** |
| **Co-requisite(s)** | | | **:** |
| **Credits:3** | **L:0** | **T:1** | **P:4** |

**Class schedule per week** : **T(1) P(4)**
**Class** : **BCA**
**Semester/Level** : **II/1**
**Branch** : **Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | To introduce students to the LaTeX typesetting system and its application in academic and scientific document preparation |
| B. | To enable students to create structured documents including reports, articles, CVs, and presentations. |
| C. | To enable learners to format documents with sections, tables, figures, and references using LaTeX commands and environments |
| D. | To familiarize students with writing and formatting mathematical expressions, equations, and symbols in LaTeX. |
| E. | To provide exposure to Overleaf and LaTeX-based publication templates |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Install and use LaTeX environments like TeXstudio and Overleaf. |
| CO2 | Write well-structured documents including titles, sections, mathematical content, and tables. |
| CO3 | Incorporate figures, references, citations, and bibliographies using BibTeX. |
| CO4 | Create scientific presentations using Beamer. |
| CO5 | Utilize LaTeX for specialized formatting like chemical structures and graphics using TikZ. |

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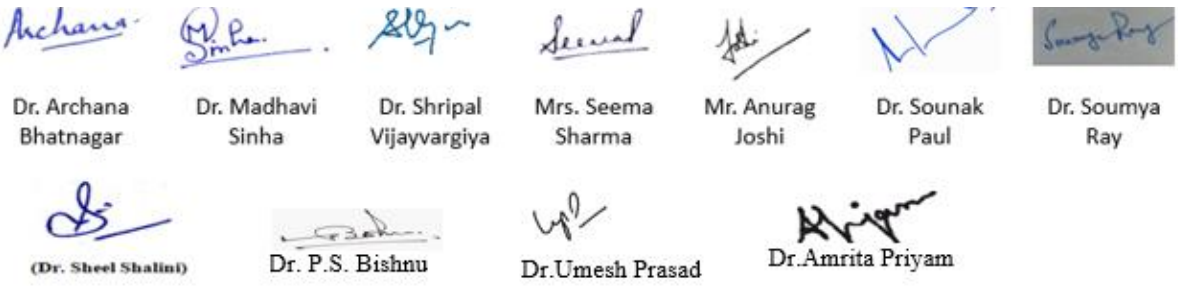
**Syllabus**

| MODULE | (No. Of Lecture Hours) |
|---|---|
| Module 1:<br>Getting Started with LaTeX:<br>Introduction to LaTeX and document preparation system, Installing TeXStudio and accessing Overleaf, LaTeX IDEs and their features, Structure of a LaTeX document, Document classes and the \documentclass command, Packages and environments, Writing the first LaTeX document | 6 |
| Module 2:<br>Formatting and Document Structure:<br>Creating title pages, chapters, sections, and subsections, Page styles and formatting text (fonts, sizes, styles), Labeling and cross-referencing, Table of Contents, special characters, line and page breaks, Columns, multi-columns, minipages, Footnotes, headers, footers, and fancyhdr package, Defining custom commands and shortcuts | 6 |
| Module 3:<br>Mathematical Typesetting with LaTeX**:**<br>Introduction to math mode and environments, Writing Greek letters, subscripts, superscripts, Fractions, summation, integrals, overline, underline, Matrices, determinants, arrays, Referencing equations, Using the amsmath package and math symbols | 6 |
| Module 4:<br>Tables, Figures, Citations, and Bibliographies:<br>Creating and formatting tables (tabular, cases, enumerate), Inserting images with \includegraphics, Creating figures and captions, Citations using BibTeX, Creating .bib files, Bibliography styles and referencing in text | 6 |
| Module 5:<br>Advanced Topics and Applications:<br>Creating presentations using the Beamer class, Themes and slide structures, Drawing graphics using TikZ: lines, shapes, annotations, Chemical structure typesetting using chemfig, Orbital diagrams, Overleaf templates for CVs, journal articles, reports, Best practices for collaborative writing | *6* |

**Implementation of the above modules in the lab experiments.**

**List of Programs as Assignment**

1. Create a basic LaTeX document that includes the title, author name, date, and a simple paragraph. Use \documentclass{article} and compile using TeXstudio or Overleaf.
2. Design a multi-section document with at least two chapters, each having multiple sections and subsections. Use labeling and cross-referencing to refer to sections.
3. Demonstrate different page styles and text formatting, including font types, sizes, bold, italic, underlined text, and color. Include both inline and displayed text.
4. Create a document with a Table of Contents, footnotes, and customized headers/footers using the fancyhdr package.
5. Write a LaTeX document demonstrating math expressions like fractions, subscripts/superscripts, roots, summations, and integrals using both inline and display math modes.
6. Create matrices and determinants using bmatrix, pmatrix, and explain the difference. Add a labeled equation and reference it in the text.
7. Insert a figure and a table into your document, add appropriate captions, labels, and center them. Ensure the figure is imported from an external file.



8. Create a complex table using tabular and multirow/multicolumn, and apply formatting like borders, alignment, and cell spacing.
9. Prepare a **.bib** file and cite at least three references using BibTeX. Use a predefined style (e.g., plain, IEEE) and generate the bibliography in your document.
10. Create a simple Beamer presentation with a title slide, outline slide, and at least 4 content slides using a predefined theme and color theme.
11. Draw a geometric shape (e.g., triangle or rectangle) using the TikZ package. Add labels, lines, and nodes to illustrate parts of the figure.
12. Use the chemfig package to draw a basic organic chemical structure (e.g., benzene or ethanol) and demonstrate orbital or structural notations.

**TEXT BOOKS:**

1. Stefan Kottwitz, *LaTeX Beginner's Guide*, Packt Publishing
2. Tobias Oetiker et al., *The Not So Short Introduction to LaTeX2ε*, Available online (free)

**REFERENCE BOOKS:**

1. H. Kopka& P.W. Daly, *A Guide to LaTeX*, Fourth Edition, Addison - Wesley, Pearson Education, 2004.
2. Leslie Lamport, *LaTeX: A Document Preparation System*, Addison-Wesley
3. Gratzer, George, *More Math Into LaTeX*, Springer

**Gaps in the Syllabus (to meet Industry/Professionrequirements)**

**POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**Postmet through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome(CO)Attainment AssessmentTools&EvaluationProcedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feed back on Course Outcome

**Mapping between Cos and ProgramOutcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 3 | 3 |
| CO2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO3 | 1 | 2 | 3 | 3 | 1 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| **CO5** | 3 | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels1, 2or3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture using Boards/LCD Projectors | CO1 | CD1, CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2, CD3, CD8 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2, CD5 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD2, CD4, CD8 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as use of NPTEL materials and the Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25122**<br>**: DATA STRUCTURES LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: Introduction to Data Structures** |
| **Credits:1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **: 03**
**Class** **:BCA**
**Semester/Level** **:II/1**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Assess how the choice of data structures and algorithm design methods impact the performance of programs. |
| B. | Choose the appropriate data structure and algorithm design method for a specific application. |
| C. | Solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps, binary search trees, and graphs and writing programs for these solutions. |
| D. | Familiarity with major algorithms and data structures and analyze performance of algorithms. |
| E. | Implementation of different sorting and searching technique and analyze their performance. |

**Course Outcomes**
After the completion of this course, students will be able to:

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| | |
|---|---|
| CO1 | Have practical knowledge on the applications of data structures. |
| CO2 | Choose an appropriate data structure given a computational problem. |
| CO3 | Design and analyze the time and space efficiency of various data structures. |
| CO4 | Analyze run-time execution of various searching and sorting methods, including insertion sort, selection sort, merge sort, heap sort and Quick sort. |
| CO5 | Justify the choice of data structure for a given problem. |

**Syllabus**

| MODULE | |
|---|---|
| **Module1 Arrays**<br>**Arrays:** Implement Static and Dynamic Arrays, perform array operations -Accessing elements, Reversing an array, Insertion and Deletion, Implement two-dimensional array, perform Addition, Multiplication, Transpose operations on 2D arrays. | |
| **Module2 Stacks & Queues**<br>**Stacks:** Implement Static and Dynamic stacks, Perform Push and Pop operations.<br>**Queues:** Implement Static and Dynamic queues, Perform Enqueue and Dequeue operations | |
| **Module3 Linked Lists**<br>Singly Linked List: Create singly linked list, perform operations -Traversing, Insertion and Deletion, Searching, Doubly Linked List: perform operations-Create, Traversing, Insertion and Deletion, Circular Linked list: perform operations- Create, Traversing, Insertion, Deletion, Searching, Implement stacks and queues using linked list. | |
| **Module4 Searching and Sorting**<br>Perform searching algorithms-Linear Search, Binary search, Perform sorting algorithms, -Insertion Sort, Selection sort, Quick sort, Merge sort, Heap sort. | |
| **Module5 Trees and Graphs**<br>Create Binary Search Tree, transverse tree using Preorder, Inorder, Postorder, perform basic binary search tree operations-Insertion and Deletion, Searching, Compute leaf count, height and depth count. Graphs: Create Adjacency Matrix, Perform Graph Transversal operations– DFS and BFS. | |

**Implementation of the above modules in the lab experiments.**

**TEXTBOOKS:**

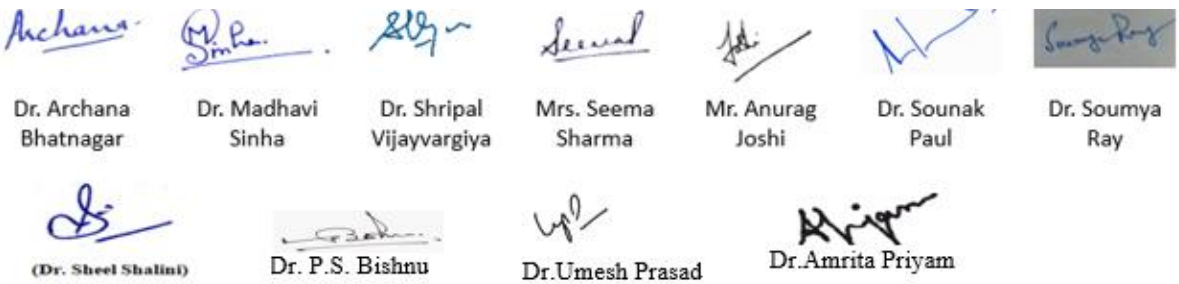
1. Pai G A V, "Data Structures and Algorithms: Concepts, Techniques and Applications", Tata McGraw-Hill.
2. Horowitz E., Sahni S., Susan A., "Fundamentals of Data Structures in C", University Press.

**REFERENCEBOOKS:**

1. Tremblay, J. P., & Sorenson, P. G. An Introduction to Data Structures with Applications McGraw-Hill.
2. Lipschutz, S. Data Structures. Tata McGraw-Hill.

**Gaps in the Syllabus (to meet Industry/Profession requirements) .**

**POs met through Gaps in the Syllabus**



**Topics beyond syllabus/Advanced topics/Design**

**Pos met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

- Student Feedback on Faculty
- Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels1,2 or 3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCDProjectors | CO1 | CD1, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD5, CD8, CD9 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2, CD9 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTELMaterials and Internets | | |
| CD9 | Simulation | | |

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| | | | |
|---|---|---|---|
| **CourseCode**<br>**CourseTitle** | | | **: CN25225**<br>**: Business Intelligence** |
| **Pre-requisite(s)** | | | **:** |
| **Co-requisite(s)** | | | **:** |
| **Credits: 3** | **L:3** | **T:0** | **P:0** |

**Class schedule per week** **: 03**
**Class** **:BCA**
**Semester/Level** **:II/1**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the fundamental concepts and components of Business Intelligence and its role in decision-making. |
| B. | Gain knowledge of data preparation techniques including cleaning, transformation, and standardization. |
| C. | Apply data mining techniques such as classification, clustering, and association to extract business insights. |
| D. | Develop skills in using BI tools for creating dashboards, reports, and data visualizations. |
| E. | Explore predictive analytics methods and emerging trends in Business Intelligence including real-time and AI-driven analytics. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Explain the architecture, components, and applications of Business Intelligence systems. |
| CO2 | Perform data cleaning, transformation, and preparation for analysis. |
| CO3 | Apply data mining techniques such as classification, clustering, and association rule mining for business decision-making. |
| CO4 | Design and develop dashboards and visual reports using BI tools. |
| CO5 | Use predictive analytics methods and interpret results to support future business planning. |

**Syllabus**

| **MODULE** | **(No. Of Lecture Hours)** |
|---|---|
| **Module 1:**<br>**Introduction to Business Intelligence (BI):** Definition, scope, and importance of Business Intelligence (BI), BI vs. Business Analytics, Components of BI architecture and BI lifecycle, Applications of BI in various industries, Overview of BI tools and platforms. | 7 |
| **Module 2:**<br>**Data Preparation and Transformation:** Data collection, integration, and cleaning, Handling missing and inconsistent data, Data standardization and normalization, Data transformation: log, root, square root. | 7 |
| **Module 3:** | 7 |

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| | |
|---|---|
| **Data Mining Techniques:** Classification, clustering, andassociation rule mining, Anomaly detection and pattern recognition, Decision trees, k-means clustering, Apriori algorithm, Interpreting mining results for business insights. | |
| **Module 4:**<br>**BI Tools and Dashboards:** Introduction to BI tools: Power BI, Tableau, Excel, Building dashboards and interactive reports, Key Performance Indicators (KPIs), Data visualization principles and best practices. | 7 |
| **Module 5:**<br>**Predictive Analytics and BI Trends:** Regression, classification, and time series forecasting, Real-time analytics, and AI in BI. | 7 |

**TEXT BOOKS:**


1. Sharda, R., Delen, D., & Turban, E. (2024). Business Intelligence, analytics, data science, and AI, Global edition (5th ed.). Pearson Education Limited.


**REFERENCE BOOKS:**


1. Howson, C. (2013). Successful Business Intelligence (2nd ed.). McGraw-Hill.
2. Shmueli, G., Patel, N. R., & Bruce, P. C. (2017). Data Mining for Business Analytics: Concepts, Techniques, and Applications in R (1st ed.). Wiley.


**Gaps in the Syllabus (to meetIndustry/Profession requirements)**

**POsmetthrough Gapsin theSyllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourseOutcome

**Mapping between COs and Program Outcomes**

| Courseoutcome | ProgramOutcomes(PO) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 1 | 3 | 1 | 2 | 1 | 1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 1 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 1 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 |
| **CO4** | 1 | 3 | 2 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 1 |
| **CO5** | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 1 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | CourseOutcome | Course DeliveryMethodUsed |
|---|---|---|---|
| CD1 | Lecture by use of Boards/ LCD Projectors | CO1 | CD1,CD2,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2, CD5,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5,CD8,CD9 |
| CD4 | MiniProjects/Projects | CO4 | CD1, CD2, CD5,CD8,CD9 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2,CD8 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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Dr. P.S. Bishnu

Dr.Umesh Prasad

Dr.Amrita Priyam

**SEMESTER III**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25201**<br>**:JAVA PROGRAMMING** |
| **Pre-requisite(s)** | | **:Programming and Problem-solving using C/C++** |
| **Co-requisite(s)** | | **:JAVA Lab** |
| **Credits:3 L:3** | **T: 0** | **P: 0** |

**Class schedule per week** **03**
**Class** **: BCA**
**Semester/Level** **: III/2**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Learn about Object oriented programming concepts. |
| B. | Learn how to use the JDK for java programming. |
| C. | Improve their programming skills in core Java using various methods, overloading and overriding of methods. |
| D. | Use java interfaces,packages and exception handling to do java-based projects. |
| E. | Use the knowledge of java to do applet programming and GUI designing. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Get clear idea about the JDK and its evolution and use it for program execution. |
| CO2 | Understand the concepts of OOP and identify the latest know-how related to the new developments in the field of Java. |
| CO3 | Apply core java to design programming-based solutions. |
| CO4 | Get clear knowledge on Dynamic memory management, generalization and specialization in Java. |
| CO5 | Do applet programming and create basic GUI in Java. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>Procedure-Oriented Programming, Object-Oriented programming, Benefits of OOP, Applications of OOP, Basics, Evolution of Java, Structure of JAVA Program, Simple Java Program, Tokens, Comments, Identifiers, Operators, Literals, Control Structures. Java Environment Setup, Compilinga Java Program, Java Virtual Machine, Philosophy of Java and Benefits. | **6** |

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| | |
|---|---|
| **Module2**<br>Data types: Primitive and reference data types, variables and constants, enumerated constants.ControlStructureinJava.Programstatements:labelledstatement,expression and null statements, compound statement, controlstatement – decision andloops, jump statement, try-throw-catch-finally statement, declaring and creating arrays, accessing array elements, assigning values to array elements, multidimensional arrays. | **8** |
| **Module3**<br>Functions:Declaration,definitionandcall,mainmethodarguments,referencevariables, method overloading, parameter passing by value for primitive types, object references andarrays,scopeofvariables,returnfrommethods.Classandobject,classmembersand initialization,accessrightsofmembers–public,privateandprotectedaccessmodifiers, constructor and copy constructor, mutability, finalization, dynamic memory management, garbage collection, this keyword, static members, scope of variables, interface – declaration, implementation and extending, package and package visibility. | **9** |
| **Module4**<br>Inheritance and Collection classes: multi-level and single inheritance, multiple inheritance of interfaces, Object class, access rights in subclasses and packages, constructor calling sequence, super keyword, dynamic binding of methods, abstract class, overriding, finalize, association, aggregation and composition. | **8** |
| **Module5**<br>Basics of Applet programming, applet code example, HTML tags for applet, applet life cycle, color, font and basic GUI handling, basic graphics, and animation. Input/Output andJAVAApplets:Stream classes–InputStream, OutputStream,Buffered Stream,file classes and handling, pushback streams,readerandwriterclasses,filereaderandwriter, serialization. | **9** |

**TEXTBOOKS:**

1. Balagurusamy E., "Programming in Java", 2nd Edition, Tata McGraw-Hill Publication, New Delhi.
2. JanaD.,Java and Object-OrientedProgrammingParadigm,PHI,2010.

**REFERENCE BOOKS:**

1. Naghton Patrick & SchildtH.,"The Complete Reference Java 2", TataMcGrawHillPublication, New Delhi.
2. Dietel Harvey M &Dietel Paul J., "Java How to program", 7th edition, Pearson Education, New Delhi.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Multithreading processing in Java.
2. Detailed Applet Programming.

**POs met through Gaps in the Syllabus: 3, 11, 12 Topics beyond syllabus/Advanced topics/Design:**

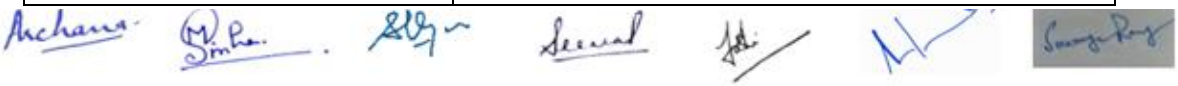
1. ConceptsofmultithreadinginJava
2. Detailed knowledge on GUI design in Java
3. Databaseconnectivitywithfrontend

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |



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| | |
|---|---|
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 1 | 3 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**Correlation Levels1,2or3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD3 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD3 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD3, CD5 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25203**<br>**:DATABASE MANAGEMENT SYSTEMS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:DBMSLab** |
| **Credits:3 L:3** | **T: 0** | **P: 0** |

**Class schedule per week** **03**
**Class** **: BCA**
**Semester/Level** **:III/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**

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Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understand the structure of databases. |
| B. | Learn Query processing and decomposition. |
| C. | Understand how to create a database. |
| D. | Learn transaction processing in databases. |
| E. | Understand how concurrency control is performed in a database. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Design a database for a given set of requirements. |
| CO2 | Use SQL. |
| CO3 | Apply normalization techniques on given database. |
| CO4 | Have knowledge of indexing and hashing mechanisms in a database management system. |
| CO5 | Have idea of the backend activities involved in extracting data from a database. Have knowledge of transaction and concurrency control mechanisms in a database management system. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction:** Purpose of Database Systems, View of Data, Data Models, Database Languages, Relational Database, Database Architecture, Database Users and Administrators, Transaction Management. | **7** |
| **Module2**<br>**Relational Data Models and Languages:** Basic Concepts, Constraints, Keys, Entity-Relationship Diagram,Weak Entity Sets, Extended E-R Features, Reduction of an E- R Diagram to Tables, The RelationalAlgebra,The Tuple Relational Calculus and The Domain Relational Calculus. | **7** |
| **Module3**<br>**Relational-Database Design:** Pitfalls in Relational-Database Design, Functional Dependencies,Decomposition, Desirable Properties of Decomposition, First Normal Form, Second Normal Form,Third normal Form, Boyce-Codd Normal Form, Fourth Normal Form and More Normal Forms. | **7** |
| **Module4**<br>**QueryProcessingandOptimization:** Overview, Measures of Query Cost, Selection Operation, Join Operation, Other Operations, Evaluation of Expressions, Transformation of Relational Expressions, Estimating Statistics of Expression Results, and Choice of Evaluation Plans. | **7** |
| **Module5**<br>**Transactions and Concurrency Control:** Transaction Concept, Transaction State, Desirable Properties of Transactions, Concurrent Executions, Serializability, Recoverability, Lock-Based Protocols, Timestamp-Based Protocols and Deadlock Handling. | **7** |

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**TEXTBOOKS:**

1. Silberschatz, Korth, &Sudarshan, "DatabaseSystemConcepts", 6thEdition, McGrawHill.

**REFERENCEBOOKS:**

1. Elmasri, &Navathe, "FundamentalsofDatabase Systems,5th Edition, Pearson Education, 2008.
2. DateC.J.,"AnIntroductiontoDatabaseSystem",PearsonEducation,NewDelhi,2005.

**Gaps in the Syllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome(CO)AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 |
| CO3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 |
| CO4 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 3 |

**Correlation Levels1, 2or3 as defined below:**

1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |

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| | | | |
|---|---|---|---|
| CD3 | Seminars | CO3 | CD1,CD5,CD2 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD8,CD9, CD5 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD8,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25205**<br>**: Computer Organization & Architecture** |
| **Pre-requisite(s)** | | **: Computer Fundamental & Digital Logic Design** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **:BCA**
**Semester/Level** **:III/2**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the Truth Table. |
| B. | Identify the number of variables and their simplification importance. |
| C. | Understand different circuits for the implementation of Boolean equations. |
| D. | Identify Register Transfer, Micro-operations and Central Processing Unit |
| E. | Describe performance evaluation of computers, computer architecture and organization, computer arithmetic, Memory and CPU design. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Minimize the circuit diagrams by use of K-Map concepts and Boolean Algebra. |
| CO2 | Analyse the outcome of the circuit designed. |
| CO3 | Create a complex circuit with use of modular block interconnection. |
| CO4 | Analyse I/O system and interconnection structures of a computer. |
| CO5 | Develop independent learning skills and be able to learn more about different computer architectures and hardware. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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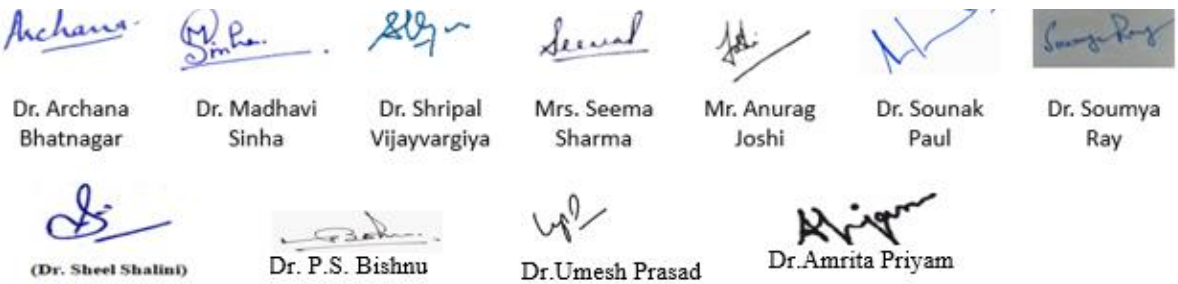
| | |
|---|---|
| **Module1**<br><br>**Module1**<br>**Digital Logic Circuits**: Digital Computers, Logic Gates, Boolean algebra, Complement of a Function, Map Simplification, Product-of-sum simplification, Don't care conditions, Combinational Circuits, Half Adder, Full Adder, Flip-Flops, Sequential Circuits<br>**Digital Components**: Decoders,Encoders, Multiplexers, Registers, Shift Registers, Binary Counters,Memory Unit, RAM, ROM, Types of ROMs.<br>**Data Representation**: Number System, Complements, Subtraction of Unsigned Numbers, Fixed-Point Representation, Floating-Point Representation, , Error Detection Codes | **7** |
| **Module2**<br>. **Register Transfer and Micro-operations**: Register Transfer language, RegisterTransfer Bus and Memory Transfers, Three-State Bus Buffers, MemoryTransfer, Arithmetic Micro- operations, BinaryAdder, Binary Adder-Subtractor, Binaryincrementer, Arithmetic Circuit Logic, Micro-operations, Shift Micro-operations, HardwareImplementation, Arithmetic Logic ShiftUnit. | **7** |
| **Module3**<br>**Basic Computer Organization and Design -**Instruction Codes ,ComputerRegisters ,Computer Instructions , Instruction Cycle,, Memory Reference Instructions ,InputOutput and Interrupt ,Design of Basic Computer, Design of Accumulator Logic | **7** |
| **Module4**<br>**Central Processing Unit**: Introduction, General Register Organization, Stack Organization, Register Stack, Memory Stack, Reverse Polish Notation, Evaluation of Arithmetic Expressions, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, ProgramInterrupt, Types of Interrupts, Reduced Instruction Set Computer (RISC). | **7** |
| **Module5**<br>**Memory Organization:** Memory Hierarchy, Main Memory, RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary Memory, Magnetic Disks and Tape, Associative Memory, Hardware Organization, March Logic, Read/Write Operation, Cache Memory, Associative Mapping, Direct Mapping, Set-Associative Mapping, Virtual Memory, Address Space and Memory Space, Address Mapping Using Pages, Associative Memory Page Table, Page Replacement, Memory ManagementHardware. | **7** |

**TEXTBOOKS:**

1. Mano M., "Computer System Architecture", Prentice Hall of India, New Delhi, 1995.(T1)

**REFERENCEBOOKS:**

1. Morris Mano M & Ciletti M.D., "Digital Design", 4th Edition, PHI, 2008.**(R1)**
2. Hayes, J.P., "Computer Architecture and Organization", 3rdEdition,McGraw-Hill, London, 2000, **(R2)**



3. Ram. B., "Computer Fundamentals: Architecture and Organization", 3rdEdition, New Age International Publication, New Delhi,2000.**(R3)**

**Gaps in the Syllabus (tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus Topicsbeyondsyllabus/Advancedtopics/Design**
**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**CorrelationLevels1,2 or 3 as defined below:**
1: Slight(Low)2:Moderate (Medium)3:Substantial(High)

**MappingBetweenCOsandCourseDelivery (CD)methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1, CD7, CD 8 |
| CD2 | Tutorials/Assignments | CO2 | CD1 and CD9 |
| CD3 | Seminars | CO3 | CD1, CD2 and CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1 and CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1 and CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25207**<br>**:MATHEMATICS FOR COMPUTING II** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:III/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand and apply the fundamental concepts of propositional logic, including truth tables, logical equivalence, and normal forms. |
| B. | Develop logical reasoning skills through various methods of proof, such as direct proof, contradiction, contraposition, and mathematical induction. |
| C. | Gain foundational knowledge in number theory, including divisibility, greatest common divisors, and prime factorization. |
| D. | Solve systems of linear equations and perform matrix operations, including finding inverses, ranks, and eigenvalues using linear algebra techniques. |
| E. | Apply basic concepts of discrete probability to compute probabilities, analyze distributions, and evaluate expected values and variances. |

**CourseOutcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Analyze and evaluate logical statements using propositional logic, truth tables, and normal forms. |
| CO2 | Apply various proof techniques including inference rules, contradiction, and mathematical induction in problem-solving. |
| CO3 | Solve problems in number theory involving divisibility, greatest common divisors, and the fundamental theorem of arithmetic. |
| CO4 | Perform matrix operations and solve linear systems using Gauss Elimination and Gauss-Jordan methods, and determine matrix rank and eigenvalues. |
| CO5 | Compute probabilities, expectations, and variances for discrete distributions and apply probability rules to solve real-world problems. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **Module1**<br>Propositional Logic: Propositions, Logical Operations (basic connectives), Compound Statements, Construction of Truth Tables, Quantifiers, Conditional and Biconditional Statements, Tautology, Contradiction, Contingency, Logical Equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF). | **8** |
| **Module2**<br>Methods of proofs: Rules of inference for propositional logic, Modus Ponens, Modus Tollens, Syllogism, etc., Consistency, Contraposition, Proof by Contradiction, Mathematical Induction. | **8** |
| **Module3**<br>Number Theory: Division algorithm, Greatest Common Divisor, Least Common Multiple, Fundamental Theorem of Arithmetic. | **8** |
| **Module4**<br>Linear Algebra: System of linear equations, Gauss Elimination method, Matrices, Gauss-Jordan method for finding matrix inverse, Elementary matrices, Matrix rank, Eigenvalues and Eigenvectors | **8** |
| **Module5**<br>Discrete Probability, Sample Space, Events, Probability of an Events, Addition and Multiplication Rule of Probability, Probability Distribution, Expectation, Standard Deviation, Binomial, Poisson and Normal Distribution | **8** |

**TEXTBOOKS:**

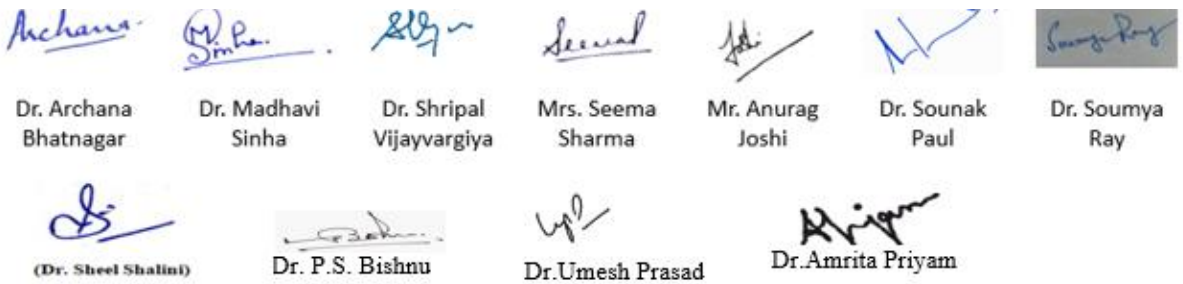

1. Kolman, B.; Busby, R. and Ross, S.: Discrete Mathematical Structures (6 Edition), Pearson Education India –ISBN 978-9332549593.
2. Rosen Kenneth H. and Krithivasan Kamala: Discrete Mathematics and its Applications, McGraw Hill, India, 2019.
3. Vasishtha A. R. and Vasishtha A. K.: Matrices, Krishna Prakashan, 2022.
4. Das N. G.: Statistical Methods, Combined Edition, Tata McGraw Hill, 2010.
5. Ross Sheldon M.: Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier, 2021.
6. S. B. Malik: Basic Number Theory, Vikash Publishing House Pvt. Ltd., 2nd Revised Edition.


**REFERENCEBOOKS:**


1. J.H.Gallier: Logic for Computer Science, JohnWiley & Sons, 1987.
2. Elliott Mendelson: Introduction to Mathematical Logic, Chapman & Hall; London, 1997
3. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan: Probability and Statistics, Schaum's Outline Series.
4. Grewal, B.S.: "Higher Engineering Mathematics,"Khanna Publication


**Gaps in the Syllabus (tomeetIndustry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/ Advanced topics/ Design**



**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| MidSemester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| EndSemester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 |
| CO2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 |
| CO3 | 2 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 | 1 |
| CO4 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 1 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2 |
| CD3 | Seminars | CO3 | CD1,CD2 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25209**<br>**:STATISTICS WITH R** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:2** | **T:0** | **P:2** |

**Class schedule per week** **L(2)**
**Class** **:BCA**
**Semester/Level** **:III/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the importance of data and how to collect,organize and summarise those data. |
| B. | Describe preliminarystatistical techniques to solve problems. |
| C. | Understand how to create a database. |
| D. | Explain the merits and limitations of different statistical techniques. |
| E. | Understand the statistical concepts, interpreting results, and using R for data manipulation and analysis. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Evaluate the need for data analysis. |
| CO2 | Formulate the statistical problem and solve it with R language. |
| CO3 | Design and describe problems of inferential statistics with R language. |
| CO4 | Understand the statistical concepts for data manipulation and analysis. |
| CO5 | Understand Basics of statistical modeling and model selection using R. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **ModuleI**<br>Introduction to Statistics: Definition of Statistics, Scope of Statistics, Types of Data. MethodsofcollectingData,DiagrammaticandGraphicPresentationofData,Graphs of Frequency Distribution. | **8** |

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| | |
|---|---|
| **ModuleII**<br>Measures of Central Tendency: Need for measuring central tendency of data; ArithmeticMean,GeometricMean,HarmonicMean,Median,Mode.meritsand demerits. Numerical exercises. | **6** |
| **ModuleIII**<br>Measures of Dispersion: Need for measuring dispersion of data; Range, Mean AbsoluteDeviation,Quartile Deviation,Standarddeviation,CoefficientofVariation: their properties, vector, merits and demerits. Numerical exercises. | **6** |
| **ModuleIV**<br>ProbabilityandProbabilityDistribution<br>Basic probability concepts, Normal Distribution, Binomial Distribution, Poisson Distribution. Other Distributions using R for probability calculations and distribution plots. | **6** |
| **ModuleV**<br>Correlation and Covariance. T-Tests, ANOVA. Linear Models. Simple Linear Regression, Multiple Regression, Generalized Linear Models, Logistic Regression, Poisson Regression, Other Generalized Linear Models. | **6** |

**List of Programs asAssignments**

1. Write an R program to take input from the user and display the values.
2. Write an R program to create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
3. Writea R program to createa vectorwhich contains 10 random integer values between - 20 and +20.
4. Write an R programto findthemaximumand theminimum valueofagiven vector.
5. Write an R program to create a list of random numbers in normal distribution and count the occurrences of each value.
6. Write an R program to read the. file and display the content.
7. Write an R program to create three vectors numeric data, character data and logical data. Display the content of the vectors and their type.
8. Write an Rprogram to createa5x4matrix, 3x3matrix with labels and fill the matrixby rows and 2 × 2 matrix with labels and fill the matrix by columns.
9. Write an Rprogram to create an array, passing in a vector of values and a vector of dimensions. Also provide names for each dimension.
10. Write an Rprogram to draw an empty plot and an empty plot specifies the axes limits of the graphic.
11. Write an Rprogram to create a simple barplot of five subjects' marks.
12. Create a scatter plot of the data points and overlay the regression line using the function plot () and abline ().
13. Customize the plot by adding axis labels,a title,and appropriate visual enhancements.
14. Perform Multiple Linear Regressions: Extend the analysis by including multiple independent variables ("x1", "x2", etc.) in the regression model. Use the function lm() with the appropriate formula.
15. Conduct model diagnostics to evaluate the assumptions of linear regression. This can include examining residual plots, checking for multicollinearity, and testing for heteroscedasticity.

**TEXT BOOKS:**

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

1. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, The Addison-Wesley Data and Analytics Series.
2. GuptaS.P.andGuptaM.P.(2015),BusinessStatistics.(SultanChand&Sons:New Delhi).18th ed.
3. DasN.G.(2017).Statistical Methods(combinedvolumes).(TataMcGraw-Hill:NewDelhi).

**REFERENCE BOOKS:**

1. RichardI.Levin, David S.Rubin, Masood H.Siddiqui (2017), Statistics for Management. (Pearson: New Delhi) 8th ed.
2. Hogg Robert V., Mckean Joeseph, Craig Allen T. (2017), Introduction to Mathematical Statistics (Pearson: New Delhi) 7th ed.

**Gaps in the Syllabus (to meet Industry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

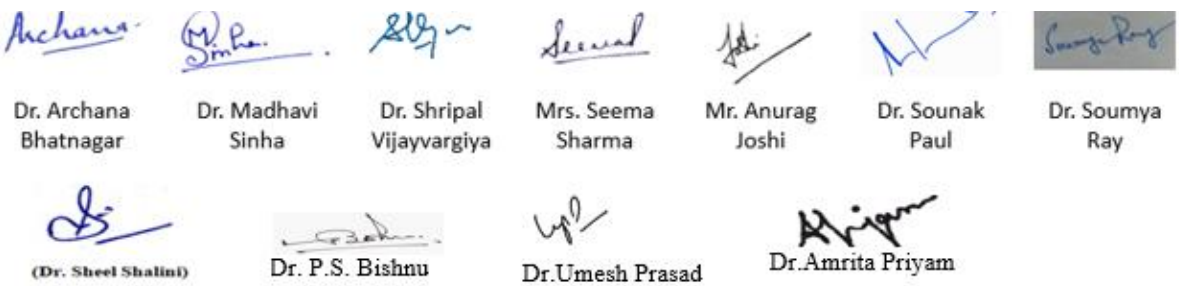
**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 |
| CO3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 |
| CO4 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)



**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD5,CD2 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD8,CD9, CD5 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD8,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25115**<br>**: COMPUTER-ORIENTED NUMERICAL METHODS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:C, C++,Language** |
| **Credits:3 L:2** | **T:0** | **P:2** |

**C schedule per week :L(2) P(4)**
**Class:BCA**
**Semester/Level:I/1**
**Branch: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the concepts of numerical approximation, error analysis, and their significance in scientific computing. |
| B. | Apply various numerical methods to find the roots of algebraic and transcendental equations. |
| C. | Solve systems of linear equations and perform matrix operations using direct and iterative numerical techniques. |
| D. | Use interpolation and numerical differentiation/integration techniques to estimate and evaluate functions based on discrete data. |
| E. | Solve ordinary differential equations numerically using initial value methods for engineering and scientific problems. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Identify and analyze different types of numerical errors and their propagation in computations. |

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| | |
|---|---|
| CO2 | Apply root-finding techniques such as Bisection, False Position, and Newton-Raphson methods to solve nonlinear equations. |
| CO3 | Solve systems of linear equations and perform matrix inversion using direct and iterative numerical methods. |
| CO4 | Construct interpolation polynomials and perform numerical differentiation and integration on tabulated data. |
| CO5 | Implement numerical methods for solving ordinary differential equations using Euler and Runge-Kutta techniques. |

**Syllabus**

| **MODULES** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>Errors and Root-Finding Methods – Absolute, relative, and round-off errors; Bisection Method, False Position Method, Newton-Raphson Method. | **6** |
| **Module2**<br>Linear Algebraic Equations – Gauss Elimination Method, Gauss-Jordan Method, Matrix Inversion using Gauss-Jordan. | **6** |
| **Module3**<br>Interpolation Techniques – Newton's Forward and Backward Interpolation, Lagrange Interpolation. | **6** |
| **Module4**<br>Numerical Differentiation and Integration – Numerical Differentiation using Interpolation, Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule. | **6** |
| **Module5**<br>Numerical Solution of ODEs – Euler's Method, Modified Euler's Method, Runge-Kutta Method (2nd and 4th order). | **6** |

List of Programs as Assignments:

1. Compute absolute, relative, and percentage errors given exact and approximate values.
2. Implement the Bisection Method to find a root of a non-linear equation (e.g., $f(x) = x^3 - 4x - 9$.
3. Implement the Newton-Raphson Method with iteration tracking and error convergence plot.
4. Solve a system of linear equations using the Gauss Elimination Method.
5. Solve the same system using the Gauss-Seidel Iterative Method and compare the results.
6. Implement Newton's Forward Interpolation and estimate the function value at a given point.
7. Implement Lagrange Interpolation for a given set of data points.
8. Compute the derivative of a function using Newton's Divided Difference Table.
9. Approximate the integral of a function using Simpson's 1/3 Rule and compare with the exact value.
10. Solve a first-order ODE using the 4th-order Runge-Kutta Method for a given initial value problem (e.g., $dy/dx = x + y, y(0) = 1$).
11. Write a program to compute the inverse of a given square matrix using the Gauss-Jordan elimination method.
12. Implement the Modified Euler's method (Heun's method) to solve a first-order ODE and compare it with the exact solution.

**TEXTBOOKS:**

1. Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (2016). Numerical methods: Problems and solutions (3rd ed.). New Age International Publishers.

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**REFERENCE BOOKS:**

1. Sastry, S. S. (2012). Introductory methods of numerical analysis (5th ed.). PHI Learning Pvt. Ltd.

**Gaps in the Syllabus (to meet Industry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome(CO) AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
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**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO3 | 1 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

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**Mapping Between COs and Course Delivery (CD)methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
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| CD2 | Tutorials/ Assignments | CO2 | CD1, CD2, CD3, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/ Projects | CO4 | CD1,CD2,CD5 |
| CD5 | Laboratory Experiments/ Teaching Aids | CO5 | CD2,CD4,CD8 |
| CD6 | Industrial/ Guest Lectures | | |

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| | | | |
|---|---|---|---|
| CD7 | Industrial Visits/ In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | | |
|---|---|---|---|
| CourseCode | | | : **CN25202** |
| CourseTitle | | | : JAVA LAB |
| Pre-requisite(s)<br>requisite(s) | | | :Programming and problem-solving using C/C++ Lab Co-<br>: Java Programming |
| Credits: 1.5 | L:0 | T:0 | P:3 |
| Class schedule per week | | 03 | |
| Class | | | :BCA |
| Semester/Level | | | :III/2 |
| Branch | | | :Bachelor of Computer Applications |

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Study the concepts of Object-oriented programming. |
| B. | Implementation and usage of JDK for java programming. |
| C. | Improve programming skills in core Java using various methods, overloading and overriding of methods. |
| D. | Use java interfaces,packages and exception handling for java-based projects. |
| E. | Apply the knowledge of java to implement applet programming and GUI designing. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Elaborate the use of JDK of various versions for programming. |
| CO2 | Identify the latest know-how related to the new developments in the field of Java. |
| CO3 | Apply the knowledge gained for their project work as well as to develop some GUI applications. |
| CO4 | Design solutions in JAVA. |
| CO5 | Apply features of Java Applets through programming. |

**Syllabus**

**List of Programs as Assignments:**

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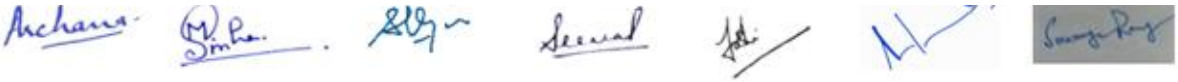
| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>WAJP to show the characteristic of a number.<br>{E.g.24ithastwocoefficients2intens<br>positionand4inunitsposition.Itiscomposedof2and3.Itisapositivenumber.<br>Also show whether it is odd or even. Tell the number of digits.}<br><br>WAJPtotakeinput throughcommandlineargument anddothe following:<br>Checkwhetherthenumberisprimeor not.<br>Countthenumberof digits.<br>WriteamenudrivenprogramusingswitchinJavatoperform following:<br>Forinput of1, check whetherthenumberisprimeor not<br>Forinput of3,find thefactorsofthe number<br>Forinput of5, checkthenumberisodd or even.<br>Forinput of7 generatethereverseofthe number<br>Writeaprogram inJavato generate<br>Hexadecimalequivalent ofanumberwithoutusing array.<br>Hexadecimalequivalent ofanumberusing array.<br>WAJPtotaketwonumberinputsthroughcommandlineargumentanddothe following:<br>CheckwhethertwonumbersareprimetoeachotherornotORevaluatetheHCF oftwo numbers.<br>FindLCMoftwo numbers. | **6** |
| **Module2**<br>WAJP to compute and display the count of occurrence of 4 in a number. E.g. 4564 will compute 2.<br>WAJP to sort a list of numbers in ascending order.<br>WAJP to generate Pascal's Triangle using a square matrix.<br>Write a program in Java to take input of two 3×3 matrices through command line argument and then:<br>Add them up and display the result<br>Subtract them and display the result<br>Generate the transpose of the matrix<br>Multiply them and display product<br>WAJP to count the number of words, characters in a sentence.<br>Write a program in Java to display the Floyd's triangle.<br>Write a program in Java to search an element using the principle of binary search (without using any built-in method)<br>Write a program in Java to print the smallest number in an array.<br>Write a program in Java to check for duplicate entries in an array. | **6** |



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| | |
|---|---|
| Write a program in Java to take input of a sentence and then count the number of words and vowels. | |
| **Module3**<br><br>WAJP to handle the Exception using try and multiple catch block; the exceptions that you will handle are, number format error, array bound error and divide byzero.<br>WAJP to create a class called **Room** with two data member length and width and then implement constructor overloading in it.<br>WAJP to create a class called **Fraction** with data member numerator and denominator; take input (through command line argument) of two fractions and then add, subtract, multiply and divide, finally display the result in reduced term.<br>Writeaprogram in Javato create aclass for**Employee**having 2 datamembercode and name. Then create 3 classes **Officer**, **AdminStaff**and **MStaff**. The **Officer** class has data members designation and pay-scale; the **AdminStaff**has data members grade and pay-band; the **MStaff**has data member department and two sub-classes **Regular** and **Casual**.The**Regular**staffhasdatamemberslevelandconsolidated-payand**Casual**has data member daily-wage. Take all inputs through constructors and write appropriate methods for displaying one data for each type of class.<br>WAJP to design a class called **Account** using the inheritance and static that show all function of bank (withdrawal, deposit) and generate account number dynamically.<br>WAJP to design an application *Password.java* that produces and prints a random password depending upon name of an individual. If the input is Abdul Kalam then the password would be *33421LAM*. Note: take the first name A=1, B=2, D=4, U=21 where 2+1=3, and L=12, where 1+2=3; so the number equivalent to ABDUL comes to be *12433*, and last 3 alphabets of the last name, so u can find out. | **6** |
| **Module4**<br>WAJPtotakeastringcount allvowelsandthendeletethesame fromthestring.<br>Write a **Patient** class which inherits from the **Person** class. Patient canagain be of twotypes, indoor and outdoor. The Patient class requires the following:<br>avariabletostorethepatientIDforthepatient<br>avariableto storethedepartmentofhospital<br>avariabletostoretheward ofhospital<br>avariabletostorethepatient's dateofjoining thehospital<br>avariabletostorethepatient 's address<br>avariabletostorethemedicalfees thatthepatientpays<br>constructormethods,whichinitializethevariables<br>amethodto calculatethe medicalfees (forbothindoorandoutdoorpatient)<br>WAJP to take a string as password and check whether it contains at least two numbers, 3 alphabets and no space in it. If any contrary throw message.<br>Write a class called **Shape** which contains a user-defined interface for **Computation**, whichcontainsmethodsforcalculationofarea,perimeterandvolume.Writefourclasses for **circle, rectangle, sphere** and **rectangular parallelepiped**, and all these classes inherit from Shape. Now take input for the following:<br>radiusofcircleand computeitsarea andperimeter<br>Lengthandbreadthofrectangleand computeitsareaandperimeter<br>Length, breadth and height for **rectangular parallelepiped** and compute its area and volume, where A=2(wl+hl+hw) and V=lwh<br>Radiusofsphere andcomputeitsareaand volume | **6** |

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| | |
|---|---|
| WriteaclasscalledEmployee,whichrequiresthefollowing:<br>avariableto storetheemployeeID<br>employee ID should be of format EMP**M**1234, EMP**S**1234, EMP**A**1234, EMP**C**1234, where M=manager, S=supervisor, A=analyst, C=clerk; number can be any no. but first three characters should be EMP<br>avariableto storetheemployeename<br>avariabletostoredepartment<br>avariabletostorecity<br>avariableto storebasicsalary<br>amethodtocalculatethe salaryofemployee<br>ifthecityis metrothen theHRAwould be30%else20%<br>iftheemployeeIDcontainMthenDAwouldbe120%,ifSthenDAwould be 110%, if A then DA would be 100%, and if C then DA would be90%<br>constructormethods,whichinitializethevariables<br>WriteaprograminJavatofindthesecond largestelementinan array. | |
| Module5<br>Write an applet program to display a simple message: "Welcome to Java Applet".<br>Create an applet that draws a rectangle, circle, and line with different colors.<br>Develop an applet that displays your name, college name, and enrollment number.<br>Write an applet that takes user name as parameter and displays a personalized welcome message.<br>Create an applet that changes the background color on init() and draws a message on paint().<br>Write an applet that draws a bar chart for 3 subjects' marks.<br>Create an applet to demonstrate use of get Parameter() to input and display user age and city.<br>Develop an applet to animate a bouncing ball. (Optional Advanced)<br>Write a program to input a string and display its reverse.<br>. Check whether a given string is a palindrome or not.<br>. Write a program to count the number of vowels and consonants in a string.<br>. Develop a program to compare two strings using equals() and compareTo().<br>. Write a program to convert a string to uppercase and lowercase.<br>. Find the frequency of each character in a given string.<br>. Write a program to count the number of words in a string.<br>. Write a program to replace all spaces in a string with hyphens (-).<br>. Create a program to remove all vowels from a string.<br>. Write a program to check whether two strings are anagrams. | 6 |

**TEXTBOOKS:**


1. BalagurusamyE.,"Programming in Java",2ndEdition, Tata McGraw-Hill Publication,New Delhi.
2. JanaD.,Java and Object-OrientedProgrammingParadigm,PHI,2010.


**REFERENCEBOOKS:**

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1. NaghtonPatrick&SchildtH.,"TheCompleteReferenceJava2",TataMcGrawHillPublication, New Delhi.
2. Dietel Harvey M &Dietel Paul J., "Java How to program", 7th edition, Pearson Education, New Delhi.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

1. Multithreading process in Java.
2. Detailed applet programming.

**POsmet through Gaps in theSyllabus3,11,12**

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. ConceptsofmultithreadinginJava
2. Detailed knowledge on GUI design in Java
3. Databaseconnectivitywithfrontend

**Pos met through Topics beyond syllabus/Advanced topics/Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
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| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | | |
|---|---|---|---|
| **CourseCode** | | | **:CN25204** |
| **CourseTitle** | | | **:DBMS LAB** |
| **Pre-requisite(s)** | | | **:** |
| **Co- requisite(s)** | | | **: Database Management Systems** |
| **Credits: 1.5** | **L:0** | **T:0** | **P:3** |

**Class schedule per week** **03**
**Class:BCA**
**Semester/Level** **:III/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the structure of databases |
| B. | Learn Query processing and decomposition |
| C. | Understand how to create a database |
| D. | Learn transaction processing in databases |
| E. | Understand how concurrency control is performed in adatabase |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Design a database for a given set of requirements |
| CO2 | Use SQL Commands |
| CO3 | Apply normalization techniques on given database |
| CO4 | Have knowledge of indexing and hashing' mechanisms in a database management system. |

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| | |
|---|---|
| CO5 | Have idea of the backend activities involved in extracting data from a database. Have knowledge of transaction and concurrency control mechanisms in a database management system |

**Syllabus**

Consider the following tables:

emp(empno, ename, job, mgr, hiredate, sal, comm, deptno, gr)

dept(deptno, dname, loc)

Write the following queries:

1. List all information about all departments from emp table.
2. List all employee names along with their salaries from emp table.
3. List all department numbers, employee numbers and their managers' numbers in descending order of deptno and sal from emp table.
4. List department names and locations from the dept table.
5. List the employees belonging to the department 20.
6. List the name and salary of the employees whose salary is more than1000.
7. List the names of the clerks working in the department 20.
8. List the names of analysts and salesmen.
9. List the details of the employees who have joined before the end of September 81.
10. List the names of employees who are not managers.
11. List the names of employees whose employee number are 7369, 7521, 7839, 7934, 7788.
12. List the employee details not belonging to the department 10, 30, and 40.
13. List the employee name and salary, whose salary is between 1000 and 2000.
14. List the employee names, who are not eligible for commission.(salary having >15,000 eligible for commission)
15. List the employees who are eligible for commission.
16. List the details of employees, whose salary is greater than 2000 and commission is NULL.
17. List the employees whose names start with an "S" (not's").
18. List the name, salary and PF amount of all the employees(PF is calculated as 10% of salary).
19. List the empno, ename, sal in ascending order of salary.
20. Display name, and sal and commission of all employees whose monthly salary is greater than their commission.

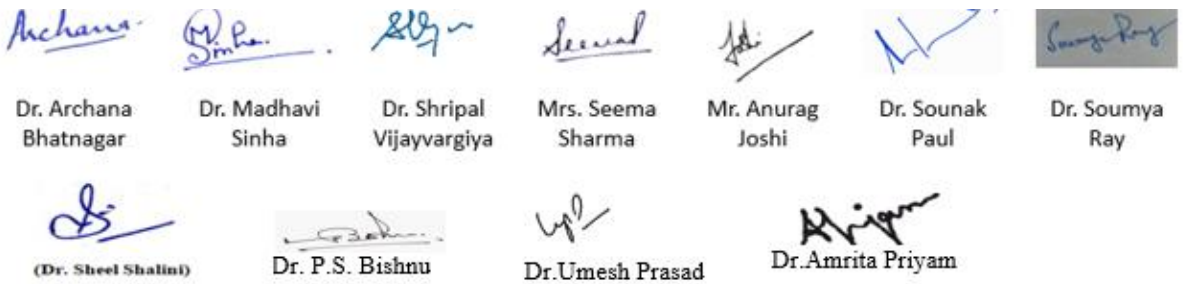
Create following tables from Book "Database System Concepts" , KORTH BOOK

1. Account_table
2. Branch_table
3. Depositor_table
4. Customer_table
5. Borrower_table

Solve the following queries using SQL.

1. Find all account numbers for account at the Redwood branch with assets greater than 300000.
2. Find the customer names, account numbers, balance for all accounts at the Perryridge branch.
3. Find the names of all branches that have assets greater than at least one branch located in Brooklyn.
4. Find the names of all customers whose street address includes the substring 'North'.
5. To find all customers having a loan, account, or both at the bank .
6. Find the average account balance at the Brighton branch.
7. Find the number of depositors for each branch.
8. Find the number of depositors for each branch where average account balance is more than1200.
9. Find the average balance for each customer who lives in Palo Alto and has at least two accounts.
10. Find the names of customers who do not have a loan at the bank, and whose names are neither Smith nor Jones.

**TEXT BOOKS:**



1. SQL, PL/SQL The Programming Language of Oracle, Ivan Bayross, 4th edition

**REFERENCE BOOKS:**

1. Beginning Oracle SQL: For Oracle Database 12c , Tim Gorman, Inger Jorgensen, Melanie Caffrey · 2014

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

**POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**Pos met through Topics beyond syllabus/Advanced topics/Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| Assessment Tool | %Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day to day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

- Student Feedback on Faculty
- Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels1, 2 or 3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between COs and Course Delivery(CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|

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| | | | |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCDProjectors | CO1 | CD1, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD5, CD8, CD9 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2, CD9 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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Dr. P.S. Bishnu

Dr.Umesh Prasad

Dr.Amrita Priyam

**SEMESTER IV**

| | | | |
|---|---|---|---|
| **CourseCode** | | | **:CN25221** |
| **CourseTitle** | | | **:SOFTWARE ENGINEERING** |
| **Pre-requisite(s)** | | | **:** |
| **Co- requisite(s)** | | | **:Software Engineering Lab** |
| **Credits: 3** | **L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **: BCA**
**Semester/Level** **: IV/2**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the fundamentals, evolution, and importance of software engineering as a discipline. |
| B. | Analyze and apply various software development life cycle models for project planning and execution. |
| C. | Learn techniques for software project management, including estimation, scheduling, and risk assessment. |
| D. | Design and model software systems using structured and object-oriented approaches, including UML. |
| E. | Explore software quality assurance, maintenance strategies, and DevOps practices for continuous improvement. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Explain the role and significance of software engineering in system development. |
| CO2 | Compare and apply suitable software life cycle models for given software projects. |
| CO3 | Develop project plans with appropriate estimation techniques, scheduling, and risk analysis. |
| CO4 | Design software systems using structured and object-oriented methodologies including UML diagrams. |
| CO5 | Evaluate software quality, reliability, and maintenance strategies including DevOps practices. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **Module1**<br>**Introduction:** The Software Engineering Discipline – Evolution and Impact, Programsvs.Software Products, Why Study Software Engineering? Emergence of Software Engineering, Notable Changes in Software Development Practices and Computer Systems Engineering.<br>**Software Life Cycles Models:** Classical Waterfall Model, Iterative Waterfall Model,Prototyping Model, Evolutionary Model, Spiral Model and Comparison of Different Life Cycle Models. | **8** |
| **Module2**<br>**Software Project Management:** Responsibilities of a Software Project Manager, Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, Empirical Estimation Techniques, COCOMO – A Heuristic Estimation Technique, Scheduling and Risk Management.<br>**Requirement Analysis and Specifications:** Requirements Gathering and Analysis and Software Requirements Specification. | **8** |
| **Module3**<br>**SoftwareDesign:** What is a Good Software Design? Cohesion and Coupling, Neat Arrangement.<br>**Software Design Approaches**, Object-Oriented vs. Function-Oriented Design, Overview of SA/SD Methodology, Structured Analysis, Data Flow Diagrams, Structured Design,<br>**Object Modelling Using UML**: Overview, UML, UML Diagrams, Use Case Model,Class Diagrams Design Patterns, Object-Oriented analysis and Design Process. | **8** |
| **Module4**<br>**Coding and Testing:** Coding, Code Review, Testing, Unit Testing, Black-Box Testing, White-Box Testing, Debugging, Integration Testing and System Testing.<br>**Software Reliability and Quality Management**: S/W Reliability, Statistical Testing, S/W Quality, S/W Quality Management System, ISO 9000, SEICMM, Personal Software Process, Six Sigma. | **8** |
| **Module5**<br>**Software Maintenance**: Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.<br>**Software Evolution**: Legacy systems, Lehman's Laws of Software Evolution, Software rejuvenation; Impact of software evolution on maintenance and project planning.<br>**DevOps Practices and Maintenance Automation**: Introduction to DevOps culture, Continuous Integration (CI), Continuous Deployment (CD), tools and automation in software maintenance. | **8** |

**TEXT BOOKS:**


1. Rajib Mall,Fundamentals of Software Engineering, 4th Edition, PHI, 2014.

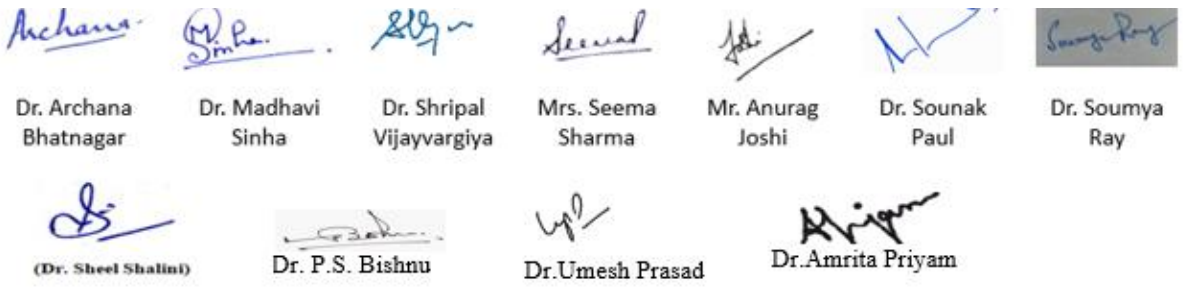

**REFERENCEBOOKS:**


1. Pankaj Jalote, An Integrated Approach to Software Engineering, 3rdEdition, Narosa, 2005.
2. Ian Sommerville, Software Engineering, 9th Edition, Pearson Education, 2011.
3. Pressman, Roger S., Maxim, Bruce R.. (2015). Software engineering: a practitioner's approach (8th ed. International student ed.). New York: McGraw-Hill Education.


**Gaps in the Syllabus (tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advancedtopics/Design**

1. Model-driven software development
2. Aspect-oriented software development



**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-2,3,4, 12

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 1 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between Cos and Course Delivery(CD )methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **Coursecode** | | **:CN25223** |
| **Coursetitle** | | **:PYTHON PROGRAMMING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Python Programming Lab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:IV/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand computer programming concepts using python language. |
| B. | Explore basic data types, control structures and standard library functions. |
| C. | Explore the basic data structures: List, Tuple, Sets, and Dictionaries available in python. |
| D | Learning Object oriented concept of programming and its implementation in python. |
| E. | Handle disk data file for input output operations. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Solve the basic mathematical problem using python programming. |
| CO2 | Use basic data types, control structures and utility functions from standard library for faster programming. |
| CO3 | Use the basic and user defined data structures as per the need of problem. |
| CO4 | Design and implement the problem using OOP concept of python. |
| CO5 | Store,retrieve and manipulate data with disk file. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **Module– I**<br>**IntroductiontoComputers,Programs,andPython:**Introduction,Programming Languages, Operating Systems, The History of Python, Features of python language, Getting Started with Python, Programming Style and Documentation, Programming Errors.<br>**Elementary Programming:** Introduction, Writing a Simple Program, Reading Input from the Console, Identifiers, Variables, Assignment Statements, and Expressions, Simultaneous Assignments, Named Constants, Numeric Data Types and Operators, Evaluating Expressions and Operator Precedence, Augmented Assignment Operators, Type Conversions and Rounding. | **8** |
| **Module– II**<br>**Mathematical Functions, Strings and Objects**: Introduction, Common Python Functions,StringsandCharacters,IntroductiontoObjectsandMethods,Formatting Numbers and Strings.<br>**Control Structures: Selections:** Introduction, Boolean Types, Values, and Expressions, **if** Statements, Two-Way **if-else** Statements, Nested **if** and Multi-Way **if-elif-else** Statements**,** Logical Operators, Conditional Expressions, **Loops**: Introduction, The **while** Loop, The **for** Loop, Nested Loops, Keywords **break** and **continue** | **8** |
| **Module– III**<br>**Functions:** Introduction, Defining a Function, Calling a Function, Functions with/without Return Values, Positional and Keyword Arguments, Passing Arguments by Reference Values, Modularizing code, The Scope of Variables, Default Arguments, Returning Multiple Values.<br>**Lists:** Introduction, List Basics, Copying Lists, Passing Lists to Functions, Returning a List from a Function, Searching Lists, Sorting, Processing Two- DimensionalLists,PassingTwo-DimensionalListstoFunctions,Multidimensional Lists. | **8** |
| **Module– IV**<br>**Tuples,Sets,andDictionaries:**Introduction,Tuples:CreatingTuples,BasicTuple Operations, Indexing and Slicing in Tuples, Tuple methods, Sets: Creating Sets, ManipulatingandAccessingSets,SubsetandSuperset,SetOperations,Comparing the Performance of Sets and Lists, Dictionaries: Creating a Dictionary, Adding, Modifying, and Retrieving Values, Deleting Items, Looping Items, The Dictionary Methods. | **8** |
| **Module– V**<br>**Objects and Classes:** Introduction, Defining Classes for Objects, Immutable Objects vs. Mutable Objects, Hiding Data Fields, Class Abstraction and Encapsulation, Object-Oriented Thinking. Inheritance and Polymorphism: Introduction,Super-classesandSubclasses,OverridingMethods,The**object**Class, Polymorphism and Dynamic Binding, The **isinstance** Function. Class Relationships: Association, Aggregation, composition.<br>**Files and Exception Handling:** Introduction, text input and output: openingafile, WritingData,TestingaFile'sExistence,ReadingAllDatafromaFile,Writingand Reading Numeric Data, Binary IO Using Pickling, Exception Handling, Raising Exceptions. | **8** |

**TEXTBOOKS:**

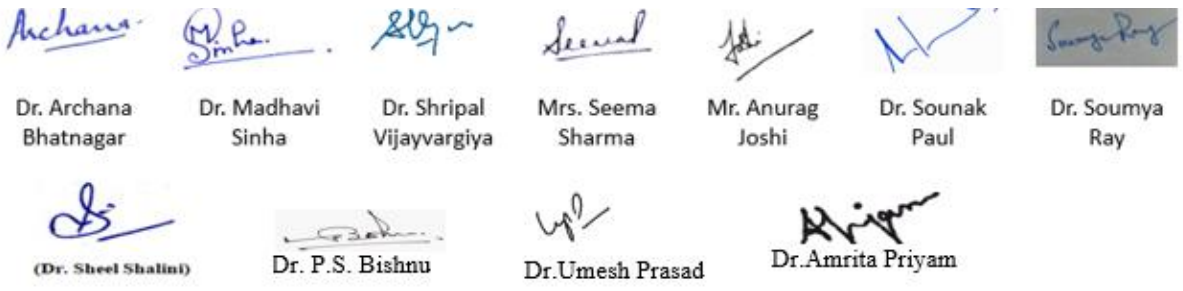
1. Y. Daniel Liang,"Introduction to programming using python", PearsonEducation;

**REFERENCEBOOKS:**

1. MartinC.Brown,"Python:The CompleteReference",McGrawHillEeducation;Forth edition (2018)
2. MarkLutz,"LearningPython"O′ReillyFifthedition(2013).
3. Mark Summerfield, "Programming in Python 3: A Complete Introduction to the Python Language" Pearson Education; Second edition (2018).

**Gaps in the Syllabus (tomeetIndustry/Profession requirements)**

1. Workingonreallifeprojectbasedonpython programming.



**POsmetthroughGapsintheSyllabus** -6, 9,11and 12

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Coverageofsomethirdpartiespythonlibrarieslike:numpy,pandasetc
2. Graphicalvisualizationusingmatplotliblibraryetc

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-4,5,8,and11

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| MidSemester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| EndSemester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**MappingbetweenCOsandProgram Outcomes**

| Course Outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels1,2 or3asdefinedbelow:**
1: Slight (Low) 2:Moderate(Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |

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| | | | |
|---|---|---|---|
| CD5 | LaboratoryExperiments/Teaching Aids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25225**<br>**:COMPUTER NETWORKS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:IV/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives:**
This course enables the students to:

| | |
|---|---|
| A. | Have a broad understanding of computer network models,software and hardware. |
| B. | Learn different transmission mediums,digital and analog signals and their transmission techniques. |
| C. | Explore error detection and correction techniques,data link protocols and standards. |
| D. | Understand network layer and transport layer protocols. |
| E. | Implement and analyze routing and congestion issues in network design, Familiarize with network security, DNS, email and encryption algorithms. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand basic concepts of networks, network hardware and network software and describe various standard network models. |
| CO2 | Understand data communication,various transmission media and familiarize with digital transmission and multiplexing techniques. |
| CO3 | Analyze error detection and correction,data link protocols,understand the role of data link layer protocols. |
| CO4 | Implement and analyze routing and congestion issues in network design. |
| CO5 | Familiarize with network security,DNS and network management algorithms. |

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**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction:** Uses of Computer Networks, Needs and Advantages, Network Hardware: Local Area Networks,Metropolitan Area Networks,Wide Area Networks, Wireless networks. Network Topology: Star, Bus, Ring, Tree, Mesh and Hybrid. NetworkSoftware: Protocol Hierarchies, Design Issues for the Layers,Interfaces and services, Connection-Oriented Versus Connectionless Service. Reference Models: The OSIReference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models. | **8** |
| **Module2**<br>**Physical Layer:** Transmission Media: Guided transmission media, wireless transmission, Communication satellites. Multiplexing: TDM, FDM, and WDM. Analog andDigitalSignals: Characteristics and their transmission.Transmission impairment. Digital Transmission: Line coding, Block coding. | **8** |
| **Module3**<br>**DataLinkLayer:**Services Provided to the Network Layer:Framing,ErrorControl, Flow Control. Error Detection and Correction: Error-Correcting Codes, Error- Detecting Codes. Elementary Data Link Protocols: Simplest, Stop-and-wait, Stop- and-wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ. HDLC Protocol.<br>IEEE standard 802 For LANS And MANS: Ethernet, 802.4 – Token Bus, 802.5 – Token Ring) Working and frame formats. Wireless LANS: IEEE 802.11: Working and frame format. | **8** |
| **Module4**<br>**NetworkLayer:**Logical Addressing:IPv4addresses,IPv6addresses.Needfor network layer. Internet Protocol: IPv4, IPv6.<br>RoutingAlgorithms:Unicast and Multicast routingProtocols.<br>**TransportLayer:** Protocols: UDP, TCP.Congestion controls. | **8** |
| **Module5**<br>**Application Layer**: Domain Name System: Name Space, Distribution, DNS in the Internet, Resolution.<br>**NetworkManagement**: System, SNMP.<br>**NetworkSecurity**: Cryptography: Introduction, Symmetric, Asymmetric.Security Services. Digital Signature. | **8** |

**TEXTBOOKS:**

1. Forouzan, B.,"Data Communication and Networking",TMH.
2. Andrew S Tanenbaum–―Computer Networks‖ –PHI.

**REFERENCEBOOKS:**

1. William Stallings – ― Data and Computer Communications ‖ – Pearson Education Asia, Seventh Edition,2001
2. Douglas E Comer-―Computer Networks and Internets‖,-Pearson Education, 2014.
3. LarryL. Peterson, BruceSDavie–Computer Networks: A Systems Approach‖, Fourth Edition,2007 (The Morgan Kaufmann Series in Networking)

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/ Advanced topics/ Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (Pos) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | | | 2 | 2 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD6 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD6,CD7 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD6, CD7 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD3,CD6, CD7 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD3, CD4, CD5, CD7 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | :**CN25227**<br>**:INTRODUCTION TO DATA SCIENCE** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:IV/2**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the fundamental concepts of data science. |
| B. | Understand the concept of ExploratoryData Analysis. |
| C. | Understand basics of Statistical methods. |
| D. | Know about the different types of regression techniques. |
| E. | Understand about inferential statistics and model evaluation. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate key concepts related to Data Science. |
| CO2 | Apply data pre-processing techniques. |
| CO3 | Do exploratory data analysis on datasets. |
| CO4 | Apply regression techniques. |
| CO5 | Apply the inferential statistics. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>**Introduction:** Definition, Data science in various fields,Facets of data,The data science process, The big data eco system and data science, An introductory working example of Hadoop. | **8** |
| **Module2**<br>**Understanding Data**: Types of data – Numeric, Categorical, and Ordinal. Classification of data: Structured, Semi-structured and Unstructured. Sources of data: Time series, Transactional data, Spatial Data, Social Network data – Date evolution.<br><br>**Data Pre-processing:** Overview, Data cleaning, Data Integration and Transformation. Data Reduction. Data Discretization. | **8** |

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| | |
|---|---|
| **Module3**<br>**Exploratory Data Analytics**: Descriptive Statistics–Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics – ANOVA. | **8** |
| **Module4**<br>**Model development:**<br>Regression models: Simple linear regression, least-squares principle, MLR, Multiple regressions, Multiple correlation, Partial correlation, Model Evaluation using Visualization. | **8** |
| **Module– 5**<br>**Statistical Inference**: Developing Initial Hypotheses, Identifying Potential Data Sources, Testing hypotheses on means, proportions, and variances.<br>Model Evaluation: Cross-validation, Underfitting and Overfitting, Model Selection. | **8** |

**TEXTBOOKS:**

1. DavyCielen, ArnoDBMeysman, MohamedAli,"Introduction to Data Science", Dreamtech Press.
2. Gupta S.P.and Gupta M.P., Business Statistics, Sultan Chand & Sons.

**REFERENCE BOOKS:**

1. Hastie, Trevor, et."The Elements of Statistical Learning", Springer.
2. Practical Statistics for Data Scientists, 2nd Edition, Peter Bruce, Andrew Bruce, and Peter Gedeck.

**Gaps in the Syllabus(to meet Industry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | Program Specific Outcomes |
|---|---|---|

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| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD3, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5, CD6, CD9 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/TeachingAids | CO5 | CD1,CD2,CD3, CD7 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25229** |
| **CourseTitle** | | **:INTRODUCTION TO ARTIFICIAL INTELLIGENCE** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:IV/2**
**Branch:BachelorofComputer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the concepts of artificial intelligence. |
| B. | Understand the various types of searching methods used in AI problems. |
| C. | Learn about basic concepts of knowledge representation. |
| D. | Learn about reasoning in the uncertain domains. |
| E. | Understand artificial neural networks. |

**CourseOutcomes**

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After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand the various approaches of artificial intelligence and Intelligent agent. |
| CO2 | Apply different search techniques for solving real world problems and finding solutions. |
| CO3 | Representing knowledge using predicate logic and a reasoning process. |
| CO4 | Explain the concepts of reasoning in the uncertain knowledge domains. |
| CO5 | Develop neural network models for various applications. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction:** Overview of Artificial Intelligence, Applications, Agent and Environment, Different types of Agents, Problem Space & Search, Problem Characteristics. | **8** |
| **Module2**<br>Searching Techniques: Solving Problems by Searching, Problem Solving Agents, Uninformed Searching Strategies: BFS, DFS, Hill Climbing Search, Simulated Annealing Search, Informed Searching Strategies: Best First Search, A* Search. | **8** |
| **Module3**<br>Using Predicate Logic: Types of Knowledge and Representation, Representing Simple Facts in Predicate Logic, Conversion to Clausal Form, Resolution,Forward Reasoning, and Backward Reasoning. | **8** |
| **Module4**<br>Probabilistic Reasoning: Representing Domain in an Uncertain Domain, Truth Maintenance System, Default Reasoning and the Closed World Assumption, Bayesian Networks. | 8 |
| **Module5**<br>Artificial Neural Networks: What is a Neural Network? Human Brain, Models of Neuron, Artificial Neural Network Architecture, Feed Forward and Feedback Network Architecture, Back Propagation Algorithm, Convolution Networks. | **8** |

**TEXTBOOKS:**


1. RusselS.andNorvigP.,"Artificial Intelligence:A Modern Approach",3rd Edition, Pearson Education, 2010.
2. Rich E. & Knight K., "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill Publishing Company Limited, 2008.


**REFERENCEBOOKS:**


1. Dan W. Patterson, "Introduction to Artificial Intelligence Expert Systems", Prentice Hall India New Delhi, 2006.
2. D.W.Rolston,"Principles of AI and Expert System Development",TataMcGraw-Hill Publishing Company Limited, 2015.


**Gaps in the Syllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

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**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD3, CD6 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD6, CD3, CD8 |
| CD3 | Seminars | CO3 | CD1, CD3, CD6, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD3, CD6, CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD2,CD6,CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self- learning suchas useof NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **Coursecode**<br>**Coursetitle** | | **:CN25231**<br>**: ENTERPRISE RESOURCE PLANNING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classschedule/week** **:03**
**Class** **:BCA**
**Semester/Level** **:IV/2**
**Branch** **:BachelorofComputer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Develop an understanding of ERP and its emerging trends. |
| B. | Explain the role of communication in ERP. |
| C. | Develop the knowledge on ERP and its related technologies. |
| D. | Explain mechanism for control, maintenance, and implementation of ERP and its life cycle. |
| E. | Explain the emerging trends of next generation enterprise. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Evaluate a good understanding of basic issues in Enterprise Systems. |
| CO2 | Analyze the scope of common Enterprise Systems (e.g., MM, SCM, CRM, HRM,procurement. |
| CO3 | Explain the challenges associated with implementing enterprise systems and their impacts on organizations. |
| CO4 | Describe the selection,acquisition and implementation of enterprise systems. |
| CO5 | Communicate and assess an organization's readiness for enterprise system implementation with a professional approach in written form. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>Overview of ERP Introduction of ERP, Need, Advantages, and Growth of ERP,MIS Integration, ERP drivers. Communication in ERP Systems: Enterprise Integration Application Tools for ERP, Network Structure of ERP System, and ERP Work flow, Process modeling for ERP Systems. | **8** |
| **Module2**<br>ERP and Related Technologies Business process Reengineering (BPR), Management Information System (MIS), Decision Support Systems (DSS), Executive Support Systems (ESS), Data | **8** |

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| | |
|---|---|
| Warehousing, Data Mining, Online Analytical Processing (OLTP), Supply Chain Management (SCM), and Customer Relationship Management (CRM). | |
| **Module3**<br>Control and Maintenance of ERP Finance, Production planning, Sales and Distribution, Human Resource Management, Inventory Control System, Quality Management, ERP Implementation Life Cycles: Evaluation and selection of ERP package, Project planning, Implementation team training & testing, End user training & Going Live, Post Evaluation and Maintenance. | **8** |
| **Module4**<br>ERP- Resource Management Perspective Business Modules in ERP Packages, Finance, Production, Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution, Resource Management. | **8** |
| **Module5**<br>Next generation enterprise Emerging trends, information mapping, role of centralized /distributed databases Linkages of the enterprise customer - enterprise, vendor enterprise, link within the enterprise and links with environment Client/server architecture. | **8** |

**TEXTBOOKS:**

1. ERPDemystified, Alexis, Leon, TataMcGraw Hill.

**REFERENCEBOOKS:**

1. EnterpriseResourcePlanning, Shankar,Ravi&Jaiswal,S.,Galgotia Publications.
2. EnterpriseResourcesPlanningandBeyond.Langenalter, A.Gary, St.LuciePress,USA.
3. Building the Customer Centric Enterprise, Imhoff, C. Loftis Lisa & Geiger, G. JonathanJohn Wiley & Sons.
4. Enterprise Resource Planning: A Manager's Guide, Diwan, Parag & Sharma, Sunil, Excel Books

**Gaps in the Syllabus (tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

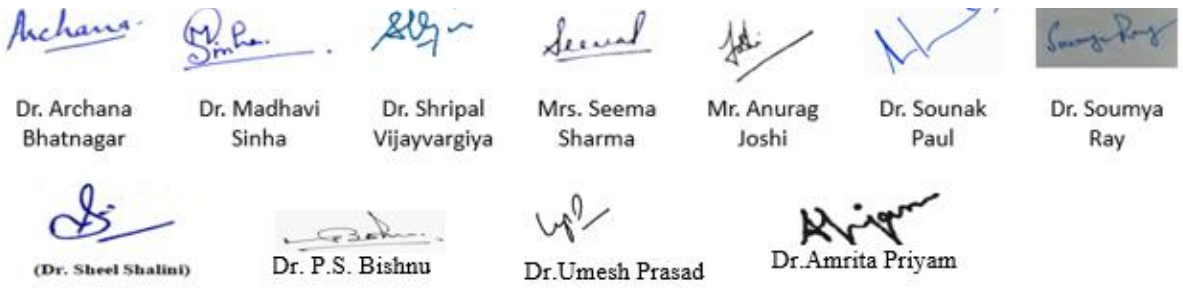
**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**



| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 1 | 3 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD3 |
| CD3 | Seminars | CO3 | CD1,CD2,CD4 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD3, CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD4 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | | |
|---|---|---|---|
| **CourseCode** | | | **:CN25222** |
| **CourseTitle** | | | **:SOFTWARE ENGINEERINGLAB** |
| **Pre-requisite(s)** | | | **:** |
| **Co-requisite(s)** | | | **:Software Engineering** |
| **Credits: 1.5** | **L:0** | **T:0** | **P:3** |

**Class schedule per week : 03**
**Class :BCA**
**Semester/Level :IV/2**
**Branch :Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A | To understand the concept of UML |
| B. | To gain knowledge of various diagrams. |
| C. | Learn about software requirement specification. |

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| | |
|---|---|
| D. | To gain knowledge about software design specification |
| E. | To learn about the relationships among different UML diagrams. |

**Course Outcomes**

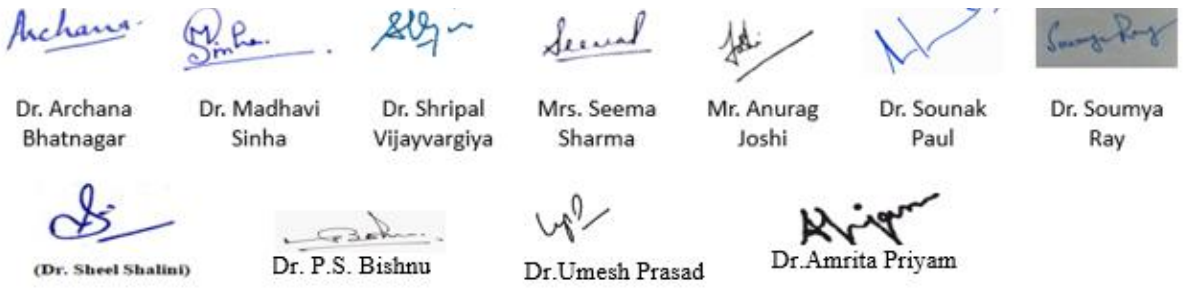
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Identify the software requirement capturing process. |
| CO2 | Elaborate knowledge about dynamic view of system. |
| CO3 | Analyze about static view of software system. |
| CO4 | Analysis about the relationship among static and dynamic view of system. |
| CO5 | Identify the process of deployment of software system |

**Syllabus**

**List of Programs as Lab Assignments**

1. Draw use case diagram for online banking system.
2. Draw use case diagram for online library system
3. Draw use case diagram for online railway reservation system
4. Draw use case diagram for employee information system.
5. Draw use case diagram for inventory control system
6. Draw use case diagram for student information system.
7. Draw use case diagram for online hotel management system.
8. Draw use case diagram for online bus reservation system.
9. Draw use case diagram for online course registration system
10. Draw use case diagram for online teacher information system.
11. Draw sequence diagram for online banking system.
12. Draw sequence diagram for online library system.
13. Draw sequence diagram for online railway reservation system.
14. Draw sequence diagram for employee information system.
15. Draw sequence diagram for inventory control system.
16. Draw sequence diagram for student information system.
17. Draw sequence diagram for online hotel management system.
18. Draw sequence diagram for online bus reservation system.
19. Draw sequence diagram for online course registration system.
20. Draw sequence diagram for online teacher information system.
21. Draw activity diagram for online banking system.
22. Draw activity diagram for online library system.
23. Draw activity diagram for online railway reservation system.
24. Draw activity diagram for employee information system.
25. Draw activity diagram for inventory control system.
26. Draw activity diagram for student information system.
27. Draw activity diagram for online hotel management system.
28. Draw activity diagram for online bus reservation system.
29. Draw activity diagram for online course registration system
30. Draw activity diagram for online teacher information system.
31. Draw class diagram for online banking system.
32. Draw class diagram for online library system
33. Draw class diagram for online railway reservation system
34. Draw class diagram for employee information system.
35. Draw class diagram for inventory control system
36. Draw class diagram for student information system.
37. Draw class diagram for online hotel management system.
38. Draw class diagram for online bus reservation system.



39. Draw class diagram for online course registration system .
40. Draw class diagram for online teacher information system

**Text Books:**
1.Mall Rajib, "Fundamentals of Software Engineering", PHI, 2005.

**Reference Books:**
1. Pressman, "Software engineering A Practitioner's Approach", MGH**.**

**Gaps in the Syllabus(to meet Industry/Professionrequirements)**

1. Estimation of software scope feasibility and resources.
2. Develop architectural diagram, and implement by following coding principles.
3. Apply testing strategies and handle software product maintenance issues.

**POs met through Gaps in theSyllabus**-3,4,1,2

**Topics beyond syllabus/Advanced topics/Design**

1. Gather and analyze system requirements
2. Develop process models and process system models
3. Translating design into coding.
4. Applying different testing strategies

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-2, 3, 4, 1, 2

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day to day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 3 | 2 | 3 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 3 |

**CorrelationLevels1,2or3as defined below:**
1:Slight(Low)2:Moderate(Medium)3:Substantial (High)

**Mapping between Cos and Course Delivery(CD) methods**

| **CD Code** | **CourseDeliveryMethods** | **Course Outcome** | **CourseDelivery Method Used** |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **Coursecode**<br>**Coursetitle** | | **:CN25224**<br>**:PYTHONPROGRAMMINGLAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:PythonProgramming** |
| **Credits: 1.5 L:0** | **T: 0** | **P:3** |

**Class schedule per week** **03**
**Class** **: BCA**
**Semester/Level** **: IV/2**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand computer programming concept using python language |
| B. | Explore basic data types, control structures and standard library functions. |
| C. | Explore the basic data structures: List, Tuple,Sets,Dictionaries available in python. |
| D. | Learning Object oriented concept of programming and its implementation in python. |
| E. | Handle disk data file for input output operations. |

**Course Outcomes**
After the completion of this course,students will be able to:

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| | |
|---|---|
| CO1 | Solve the basic mathematical problem using python programming |
| CO2 | Use basic data types control structures and utilityfunctionsfrom standard libraryfor faster programming. |
| CO3 | Use the basic and user defined data structures as per the need of problem. |
| CO4 | Design and implement the problem using OOP concept of python. |
| CO5 | Store, retrieve and manipulate data with disk file. |

**Syllabus**

**List of Programs as Assignments:**

1. Write a program that displays"Hello to Python programming".
2. Write a program to read two integers and perform arithmetic operations on them (addition, subtraction, multiplication and division).
3. Write a program to read the marks of three subjects and find the average.
4. Surface area of a prism can be calculated if the lengths of the three sides are known.
5. Write a program that takes the sides as input(read it as integer)and prints the surface area of the prism (Surface Area = 2ab + 2bc + 2ca)
6. A plane travels 395,000 meters in 9000 seconds.Write a program to find the speed of the plane (Speed = Distance / Time).
7. You need to empty out the rectangular swimming pool which is 12 meters long, 7 meters wide and 2 meter depth. You have a pump which can move 17 cubic meters of water in an hour. Write a program to find how long it will take to empty your pool? (Volume = l * w * h, and flow = volume/time).
8. Write a program to convert temperature from centigrade (read it as floatvalue) to Fahrenheit.
9. Write a Program to Prompt for a Score between 0.0 and 1.0. If the Score Is Out of Range, Print an Error.If theScore Is between 0.0and1.0,Print Grade Using theFollowingTable

.

| Score | Grade |
|---|---|
| >= 0.9 | A |
| >= 0.8 | B |
| >= 0.7 | C |
| >= 0.6 | D |
| < 0.6 | F |

10. Write a Program to find the maximum of three numbers.
11. Suppose you want to develop a program to play a lottery.The program randomly generates a two-digit number, prompts the user to enter a two-digit number, and determines whether the user wins according to the following rules:

a) If the user's input matches the lottery in the exact order, the award is $10,000.
b) If all the digits in the user's input match all the digits in the lottery number,the award is $3,000.
c) If one digit in the user's input matches a digit in the lottery number,the award is $1,000.

12. Write a Program to Check If a GivenYear Is a Leap Year.
13. Program to Find the GCD of Two Positive Numbers.
14. Write aprogram that prompts the user to enter a four-digit integer and displays the number in reverse order.
15. Write Python Program to Find the Sum of Digits in a Number
16. Write a program to print the sum of the following series.
    - 1+1/2 +1/3 +. …. +1/n
    - $1/1 +2^2/2 + 3^3/3 +…….+n^n/n$
17. Write a Program to Display the Fibonacci Sequences up to nth Term Where n is Provided by the User.

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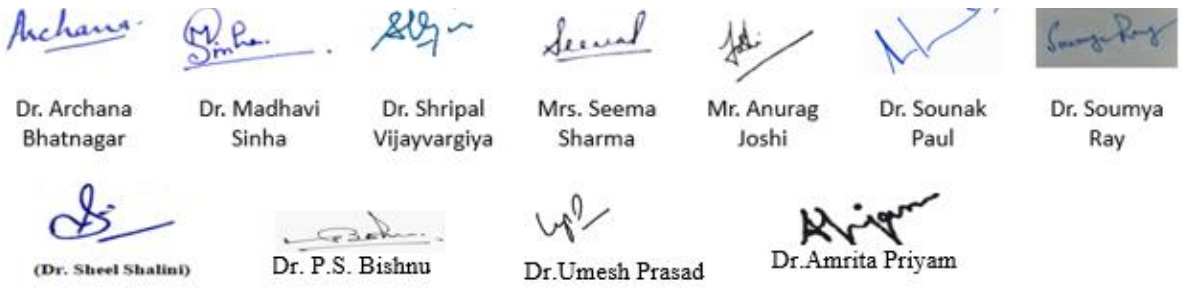
18. Writea Program to Find theSum ofAll Odd and Even Numbers up to a NumberSpecified by the User.
19. Write a Program to Check Whether a Number Is Prime or Not.
20. Write a Program to Find the Factorial of a Number.
21. Write a Program to Demonstrate the Return of MultipleValues from a Function Definition.
22. Program to Demonstrate the Use of Default Parameters
23. Write Program to Demonstrate the Scope of Variables.
24. Program to Print the Characterswhich are Common inTwo Strings.
25. Write a program to check whether a given String is palindrome or not.
26. Write Program to Count the Number of Times an Item appears in the List.
27. Write a program to create a list of integernumbers.Sorttheelementsusinganysorting method.
28. Write a program to create a list of integer numbers and perform the linear and binarysearch.
29. Write a program to create a list of cities names and perform the sorting the cities name in alphabetical order.
30. Find Mean, Variance and Standard Deviation of List of Numbers
31. Write a Program toFind theTranspose of a Matrix.
32. Write a program to perform matrix multiplication.
33. Write a program to create a dictionary for country name as key and currency as value. Traverse the dictionary with key: value Pairs in using for Loop.
34. Write a program to create tuples, and perform the following operations: Merging of tuples, splitting of a tuple, comparison of two tuples.
35. Write a program to create an intersection, union, set difference,and symmetric difference of sets.
36. Write a program with "MyRectangle" class having the dimensions as data members and area () as a method member.Calculate the area of each rectangle object created by user.
37. Design a class with name "MyComplex" to represent the complex number including the constructor overloading,methods to perform the arithmetic operation over the two complex numbers. Write the complete python program for the above design.
38. Design a class with name "Distance" to represent the distance in feet and inch. Include the method to calculate the addition of two distances.Write the complete python program for the above design.
39. Write a complete program to implement the Employee and its subclasses (Salarayed Employee, Daily Waged Employee, Commission based employee) given in Hierarchical and multilevel manner.The program should exhibit the use of super keyword to invoke the super class constructor.
40. Write a program to open a file and perform the reading and writing operation with the file.
41. Write a program to count the frequencies of each word from a file.
42. Write a program to copy the text of a file to another file.
43. Write a program to append a file with the content of another file.
44. Write a program to compare two files.
45. Write a program to delete and insert a sentence at specified position in a file.
46. Write a program to delete a sentence from a file if the file contains a specific word.
47. Write program to delete comment lines from a file.
48. Write a program to capitalize each word of the file.
49. Write a program to handle an exception using exception handling mechanism of python.
50. Write a program to raise an exception explicitly using raise keyword.

**TEXT BOOKS:**

1. Y. Daniel Liang, "Introduction to programming using python", Pearson Education

**REFERENCEBOOKS**:

1. MartinC.Brown,"Python:TheCompleteReference",McGrawHillEducation
2. MarkLutz,"LearningPython"O′Reilly



3. MarkSummerfield,"ProgramminginPython3:ACompleteIntroductiontothePython Language" Pearson Education

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | ProgramOutcomes (POs) | | | | | | | | | | | | ProgramSpecific Outcomes(PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels1,2 or3asdefinedbelow:**
1: Slight (Low) 2:Moderate(Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/Teaching Aids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |

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| | | | |
|---|---|---|---|
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

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**SEMESTERV**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25301**<br>**:FUNDAMENTALS OF COMPUTER ALGORITHMS** |
| **Pre-requisite(s)** | | **:Introduction to Data Structures** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:V/3**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand basic algorithm designing techniques such as recursion, greedy, dynamic programming and backtracking. |
| B. | Analyze the asymptotic performance of an algorithm. |
| C. | Demonstrate a familiarity with algorithms and data structures. |
| D. | Apply important algorithmic design paradigms and methods of analysis in solving real life problems. |
| E. | Synthesize efficient algorithms in common engineering design situations. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Have a clear understanding on solving the problems systematically. |
| CO2 | Make use of linear and non-linear data structures,like,graphs and treeswhile designing algorithms. |
| CO3 | Have a clear understanding of different design paradigms. |
| CO4 | Analyze and measure the efficiency of an algorithm. |
| CO5 | Demonstrate the basic knowledge of fundamentals of algorithms which would help them to take up an advanced course in the same field. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>**Introduction:** Definition of algorithm, **a**lgorithm design techniques, **a**nalysis of algorithms, performance analysis-time complexity, best**, w**orst and **a**verage cases, space complexity.<br>**Asymptotic Notations:** O, Ω, Θ | **10** |

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| | |
|---|---|
| **Module2**<br>**Recursion:** Basic concept. Analysis of recursive algorithms, Master's theorem.<br>**Divide&Conquer**: The general method.Binarysearch,merge sort,quicksort,best- andworst-caseanalysis,multiplicationoflargeintegers,Strassen'sMatrix multiplication. | **10** |
| **Module3**<br>**TheGreedyMethod:**<br>General Characteristics of greedy algorithms, problem solving using greedy methodology: Knapsack problem, Minimum Spanning trees (Kruskal's algorithm, Prim's Algorithm), single source shortest path problem (Dijkstra's algorithm), Huffman trees. | **10** |
| **Module4**<br>**DynamicProgramming**:The general method,principles of dynamic programming: memorization or iterations over sub problems, all-pairs shortest path problem, 0/1 Knapsack problem. | **10** |
| **Module5**<br>**BasicTraversalandsearchtechniques**ongeneralgraphs:BFS&DFS<br>**LimitationsofAlgorithmPower:**<br>**Backtrackingmethod:**4-Queensproblem,Sumofsubsetproblems<br>**ComputationalIntractability**:OverviewofP,NPandNP-Complete Problems | **10** |

**TEXTBOOKS:**

1. JonKleinbergandEvaTardos.AlgorithmDesign. PearsonEducation(LatestEdition).
2. AnanyLevitin.IntroductiontoTheDesignandAnalysisofAlgorithms.PearsonEducation (3rd Edition).

**REFERENCE BOOKS:**

1. Sahni Sartaj.ComputerAlgorithms.ComputerSciencePress (Latest Edition)
2. T.H.Cormen. Introduction to Algorithms.3Ed.(International Edition) (MIT press)

**Gaps in the Syllabus(to meet Industry/Profession requirements)**

1. Polynomials and the FFT; Approximation Algorithms

**POsmetthroughGapsin theSyllabus** -3, 4, 5

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| MidSemester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| EndSemester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **CO1** | 3 | 2 | 1 | 3 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO2** | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 |
| **CO3** | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 |
| **CO4** | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 |
| **CO5** | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |

**CorrelationLevels1,2 or3asdefinedbelow:**
1: Slight (Low) 2:Moderate(Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD8 |
| CD3 | Seminars | CO3 | CD1,CD5,CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/Teaching Aids | CO5 | CD1,CD2,CD3, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25303** |
| **CourseTitle** | | **:INTRODUCTION TO MACHINE LEARNING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:MachineLearningLab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **: BCA**
**Semester/Level** **: V/3**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Introduce the basic concepts and techniques of MachineLearning. |

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| | |
|---|---|
| B. | Familiarize the concepts of regression models. |
| C. | Understand the concepts of feature selection and transformation techniques. |
| D. | Learn the utility of classification and clustering techniques. |
| E. | Identify machine learning algorithms for real-world problems. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Understand the basic concepts required for mchine learning. |
| CO2 | Apply regression models for prediction. |
| CO3 | Identification of discriminating features for better learning and apply classification algorithm. |
| CO4 | Evaluate and analyze the performance of a machine learning algorithm or a system based on machine learning algorithm. |
| CO5 | Apply artificial neural network for the real-world data. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction:** Machine Learning, Types of Machine Learning: Supervised, semi-supervisedandunsupervisedlearning.BasicsofLinearAlgebra-matricesandvectors, Eigen value decomposition. | **8** |
| **Module2**<br>**Feature selection, Feature transformation:** Filter and Wrapper methods, Encoding schemes for data transformation, Principal component Analysis.<br><br>**Supervised Learning:**<br>Linear Regression: Prediction using Linear Regression, Linear Regression with one variable, Linear Regression with multiple variables. | **8** |
| **Module3** | |
| Logistic Regression: Classification using Logistic regression, Logistic regression vs. Linear regression, Logistic regression with one and multiple variables.<br><br>**Classification:** Classification, Issues regarding classification, Techniques: Bayesian classification, Support Vector Machine, Decision Tree. Kernel trick | **8** |

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| | |
|---|---|
| **Module4**<br>**Unsupervised Learning**: Clustering: Introduction, Partitioning- K-Means, Hierarchical - agglomerative and Divisive clustering.<br><br>**Model Assessment and Selection:** Bias, Variance and model complexity, Bias – variance tradeoff, Bayesian approach and BIC, Cross-validation, Performance of Classification Algorithms (Confusion Matrix, Precision, Recall and ROC Curve).<br><br>**Regularization:** Regularization and its utility:the problem of Overfitting,Application of Regularization. | **8** |
| **Module5**<br>**Artificial Neural Networks**: Introduction, Model Representation, Perceptron, Forward propagation, Backpropagation algorithm, regularization and bias/variance. Recurrent networks. | **8** |

**TEXTBOOKS:**

1. Alpaydin, Introduction toMachine Learning, Prentice Hall of India.
2. MitchellTom,"MachineLearning",LatestEdition,Mc-GrawHill.

**REFERENCEBOOKS:**

1. Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das, "Machine Learning", Pearson Education India.

**Gaps in theSyllabus (tomeetIndustry/Profession requirements)**

1. Application of machine learning in real life problems.

**POsmetthrough Gapsin theSyllabus –**PO4, PO5

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Design of machine learning system to solve complex problems.
2. Capability to optimize machine learning models with applications in real-world use cases.

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design–**PO3, PO4, PO5

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **CO1** | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| **CO4** | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD3, CD5 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD5, CD6, CD9 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD3, CD6 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25305** |
| **CourseTitle** | | **:COMPUTER GRAPHICS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:ComputerGraphicsLab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule perweek** **03**
**Class** **: BCA**
**Semester/Level** **: V/3**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

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| | |
|---|---|
| A. | Acquire fundamental knowledge of the role of multimedia and graphics in computer science. |
| B. | Learn various object modeling algorithms and computations related to it. |
| C. | Learn to model and colour 2D and 3D objects. |
| D. | Learn to develop a simple Graphical User Interface. |
| E. | Learn to create realistic images using color and shading techniques. |

**CourseOutcomes**

After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Perform visual computations for geometrical drawings. |
| CO2 | Model 2D objects. |
| CO3 | Apply geometrical transformation of the modeled objects. |
| CO4 | Develop a simple Graphical User Interface. |
| CO5 | To create realistic images using color and shading techniques. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction and Overview of Graphics Systems**: Overview of graphics systems, ApplicationareasofComputerGraphics,VideoDisplayDevices,RasterandRandom Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard Copy Devices,and Graphics Software.Three-Dimensional ViewingDevices,Stereoscopic & Virtual Reality Systems. | **8** |
| **Module2**<br>**Output Primitives**: Points and Lines, Line Drawing Algorithms (DDA and Bresenham's Algorithms), Circle Generating Algorithm, Filled Area Primitives – Scan-line Polygon Fill Algorithm, Inside-Outside Tests, Boundary-Fill Algorithm, Flood-Fill Algorithm, Color Tables. | **8** |
| **Module3** | **8** |
| **2D Geometric Transformation:** Two-dimensional transformations and their matrix representations-Translation, Rotation, Scaling, Reflection, Shears, Homogeneous Coordinates, and Composite Transformations (Translations, Rotations, Scalings).<br>**2DViewing:**TheViewingPipeline,ViewingCoordinateReferenceFrame,Window- to- Viewport Coordinate Transformation, Clipping- Point, Line Clipping -Cohen- Sutherland Line Clipping and Polygon Clipping -Sutherland- Hodgeman Polygon Clipping. | |

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| | |
|---|---|
| **Module4**<br>**3D Geometric Transformations and Viewing:** Translation, Rotation-Coordinate Axes Rotation, General 3-Dimensional Rotations, Rotations with Quaternions, Scaling, The Viewing Pipeline, Viewing Coordinates. | **8** |
| **Module5**<br>**Color Models**: Properties of Light, Standard primaries and chromaticity diagram, XYZcolormodel,RGBcolormodel,YIQcolormodel,HSVcolormodel,HLScolor model<br>**Visible Surface Detection Method:** Classification of visible surface detection algorithm, Back Face Detection, Depth- Buffer method, A-Buffer method, and Scan line method. | **8** |

**TEXTBOOKS:**

1. D.HearnandM.P.Baker,"ComputerGraphics:CVersion",2ndEdition,Pearson Education, 2013.

**REFERENCEBOOKS:**

1. FoleyJ.D., DamA. Van, Feiner S.K., and Hughes.F., "Computer Graphics:Principlesand Practice in C", 3rd Edition, Pearson Education, 2013.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

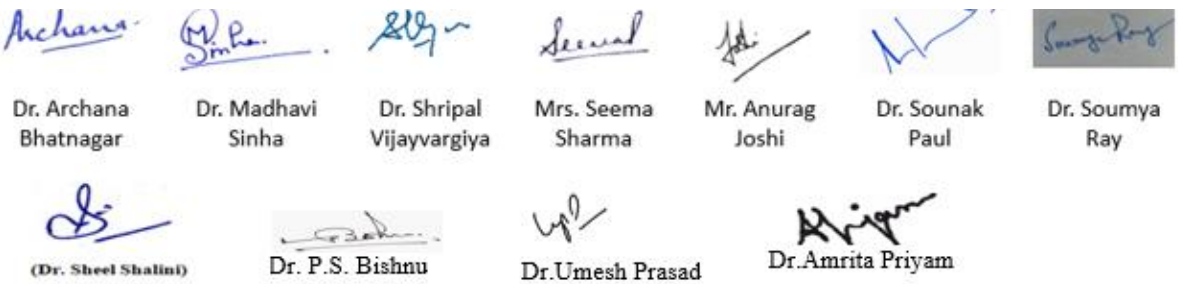
| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty

2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**



| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels1,2,or3asdefinedbelow:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD4, CD5 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchastheuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25307** |
| **CourseTitle** | | **:WEB PROGRAMMING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Web Programming Lab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **:03**
**Class** **:BCA**
**Semester/Level** **:V/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Learn about the basics of web programming. |
| B. | Learn HTML, Java Script, XML for scripting. |
| C. | Learn web-based programming using ASP.NET. |

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| | |
|---|---|
| D. | Learn PHP based programming. |
| E. | Learn Making static and dynamic websites. |

**Course Outcomes**

After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Understand the elements of HTML and design static web pages. |
| CO2 | Get familiarized with .net framework. |
| CO3 | Develop interactive web pages using XML. |
| CO4 | Design dynamic website using ASP.net. |
| CO5 | Learn basics of PHP and apply it to develop dynamic websites. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>Introduction to Internet and HTML:Introduction to Internet,InternetServices,Web Server, Web Client, Domain Registration, Internet Security. HTML Tags, HTML Documents, Header Section, Body Section, Headings, Link Documents using AnchorTag,FormattingCharacters,Fonttag, ImagesandPictures,Listing,Tables in HTML, HTML iframes, HTML Forms. | **8** |
| **Module2**<br>JavaScript:Use of Java Script in Web Pages,AdvantagesofJavaScript,DataTypes, Variables,OperatorsandExpressions,ConditionalStatements,ArrayObjects,Date Objects, String Objects, Type Casting, Functions, DOM.<br>Introduction to Javascript Frameworks, Library and Runtime Environment: React, Angular, Node.js, Express.js. | **8** |
| **Module3**<br>Understanding XML: Overview of XML, XML Families of Technology, Creating XML Documents, Rules for Well-Formed XML, Discerning Structure, Working with Mixed content, Adding Comments, CDATA Sections, Creating a DTD-The Concept of a Valid XML Document, Creating a DTD for an existing XML File | **8** |
| **Module4**<br>ASP .NET: Building Web Forms Using ASP .NET, Exploring ASP .NET Server Controls, Using ASP.NET Server Controls to Create Web Forms, Understanding the Code behind the Page. Using Validation Controls to Improve Web Forms. | **8** |
| **Module5**<br>PHP: Preparing the Use PHP, Exploring PHP for the First Time, Understanding PHP Basics, Displaying PHP Output, Managing PHP Program Flow. Planning a PHP Web Application, Creating and Using a Logon Window, Managing System Data, Updating a PHP Web Application. | **8** |

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**TEXTBOOKS:**

1. XavierC.,"WebTechnology&Design",NewAgeInternationalPublishers,New Delhi.
2. Bai Xue, Ekedahl Michael, Farrell Joyce, Gosselin Don, Zak Diane, Kaparthi Shashi, MacintyrePeter,MorrisseyBill,"TheWebWarriorGuidetoWebProgramming",India Edition, Thomson Education.
3. StevenHolzner, PHP: The Complete Reference,McGrawHillEducationPvtLtd.

**REFERENCEBOOKS:**

1.Ivan Bayross,"Web Enabled Commercial Application Developing Using HTML, Java Script, DHTML and PHP. , BPB Publication

2.MacDonald, The Complete Reference ASP.Net, Tata McGraw Hill

3. James Jaworski, "Mastering JavaScript and Jscript", BPB Publication.

**Gaps in theSyllabus(tomeetIndustry/Professionrequirements)**

**POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight(Low) 2:Moderate (Medium)3:Substantial(High)

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**MappingBetween Cos and Course Delivery (CD)methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD6 |
| CD2 | Tutorials/Assignments | CO2 | CD7 |
| CD3 | Seminars | CO3 | CD2, CD3, CD6, CD7 |
| CD4 | Mini Projects/Projects | CO4 | CD3,CD6,CD7 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD2,CD3,CD4, CD5, CD6, CD7 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25309** |
| **CourseTitle** | | **:SOFTWARE TESTING** |
| **Pre-requisite(s)** | | **:Software Engineering** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:V/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Have a broad understanding of software requirements in context to end user expectations. |
| B. | Familiarize with testing environments and test processes. |
| C. | Describe to the students the impact and methods to overcome programming errors. |
| D. | Devise strategies to detect and rectify common programming errors. |
| E. | Conceptualize the role of testing in estimating software quality. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Understand the types and effects of errors and bugs on a software and the testingprocess. |

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| | |
|---|---|
| CO2 | Apply testing strategies to detect software bugs. |
| CO3 | Analyze approaches of verification and validation including static analysis, and reviews as well as software testing approaches such as unit testing and integration testing. |
| CO4 | Evaluate the software quality and apply test suites like JUnit and selenium for testing software. |
| CO5 | Summarize best practices for coding to ensure good quality software,quality products by applying quality metrics. |

**Syllabus**

| MODULE | (NO.OF LECTURE HOURS) |
|---|---|
| **Module1**<br>Introduction: Software Testing – Psychology of Testing, Verification and Validation, Testing Team and Development Team, Characteristics of Test Engineers, Levels of Testing Principles of Software Testing, Error, Fault, Failure, Incident, Error and Fault Taxonomies, Test Cases, Limitations of Testing Code inspections, deskchecking, group walkthroughs and peer reviews. Overview of Graph Theory for tester. | **8** |
| **Module2**<br>FunctionalTesting:BoundaryValueAnalysis,EquivalenceClassTesting,Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Path testing,DD-Paths,CyclomaticComplexity,GraphMetrics,DataFlowTesting,Slice based testing. | **8** |
| **Module3**<br>Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Regression Testing, Extreme Testing. | **8** |
| **Module4**<br>Object Oriented Testing: Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing. Testing Internet applications:Overview, challenges and strategies of testing internetapplications. | **8** |
| **Module5**<br>Overview of Testing Tools – Need for Automated Testing Tools, Taxonomy of Testing Tools, Functional/Regression Testing Tools, Performance Testing Tools, Testing Management Tools, Source Code Testing Tools, How to select a Testing Tool. WinRunner – Overview of WinRunner, Testing Applications using WinRunner. | **8** |

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**TEXTBOOKS:**

1. JorgensenPaulC.,"SoftwareTesting-ACraftsman'sApproach",SecondEdition,CRCPress, 2008.
2. AmmannPaulandOffuttJeff,"IntroductiontoSoftwareTesting",CambridgeUniversityPress, Cambridge,UK, ISBN 0-52188-038-1, 2008.

**REFERENCEBOOKS:**

1. TamresLouise,"SoftwareTesting",PearsonEducationAsia,2002.
2. Pressman RogerS.,"SoftwareEngineering–APractitioner'sApproach",Fifth Edition,McGraw-HillInternational Edition, New Delhi, 2001.
3. Aggarwal K.K.& Singh Yogesh, "Software Engineering", New Age International Publishers, New Delhi,20034.Tamres Lauise, "IntroducingSoftware Testing",Pearson Education

**GapsintheSyllabus(tomeetIndustry/Professionrequirements)**

1. Combinationofmanualandautomatedtesting.

**POsmetthroughGapsintheSyllabus-**3,5,12

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Testingforemerging applicationssuchasMachinelearning,Bigdata etc.
2. Digitaltransformationwith Agile.

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**5,12

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | ProgramOutcomes(POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 3 | 2 | 3 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low)2:Moderate(Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2, CD3 |
| CD4 | MiniProjects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1, CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials andInternets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25304** |
| **CourseTitle** | | **:MACHINE LEARNING LAB** |
| **Pre-requisite(s)** | | **:PythonProgrammingLab** |
| **Co-requisite(s)** | | **:IntroductiontoMachineLearning** |
| **Credits:1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:V/3**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understand the fundamental concepts of machine learning, its types, and the mathematical foundations required, including matrix operations and eigen decomposition. |
| B. | Apply feature engineering techniques such as manual encoding, transformation, and dimensionality reduction using PCA for effective model input preparation. |
| C. | Develop regression and classification models including linear regression, logistic regression, Naive Bayes, and decision trees using foundational algorithms. |
| D. | Implement unsupervised learning techniques like K-means clustering and evaluate models using standard performance metrics such as confusion matrix, precision, recall, and accuracy. |
| E. | Design and simulate artificial neural networks including perceptron and feedforward networks using NumPy, gaining a practical understanding of forward and backpropagation mechanisms. |

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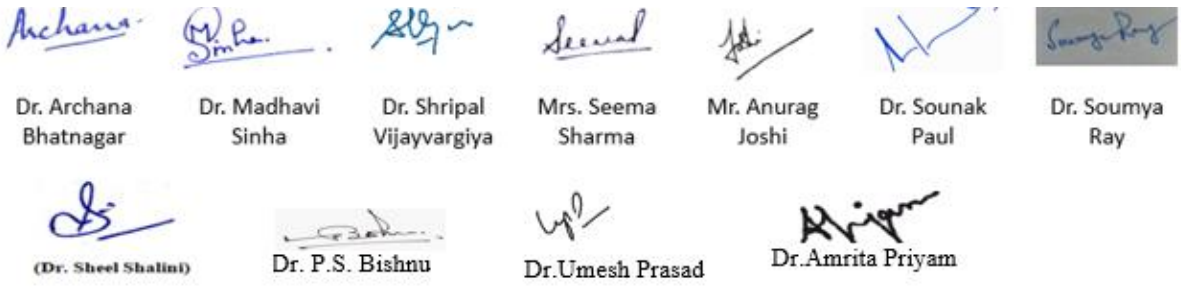
**CourseOutcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Apply matrix operations and eigen decomposition techniques to understand and solve mathematical foundations of machine learning algorithms. |
| CO2 | Perform feature encoding, transformation, and dimensionality reduction to preprocess data for learning models. |
| CO3 | Develop and implement regression and classification algorithms such as linear regression, logistic regression, Naive Bayes, and decision trees using Python. |
| CO4 | Apply unsupervised learning techniques like K-Means clustering and evaluate model performance using appropriate validation metrics. |
| CO5 | Design and simulate artificial neural networks using NumPy to understand the functioning of perceptrons, forward propagation, and backpropagation. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| Module 1: Introduction to ML & Linear Algebra<br>**Topics: ML types, matrix operations, eigen decomposition**<br>. Perform addition, multiplication, and transpose of two matrices using NumPy.<br>. Compute eigenvalues and eigenvectors of a 2×2 matrix using NumPy's linalg module. | 4 |
| **Module 2: Feature** Engineering**& Linear Regression**<br>**Topics: Feature selection, transformation, regression**<br>. Convert a categorical list (e.g., ['red', 'green', 'blue']) to numerical form using a dictionary (manual label encoding).<br>. Apply Principal Component Analysis using covariance matrix and eigen decomposition with NumPy.<br>. Implement simple linear regression (one variable) using the least squares method with NumPy. | 4 |
| **Module 3: Logistic Regression & Classification**<br>**Topics: Logistic regression, classification, kernel methods**<br>. Build logistic regression from scratch using the sigmoid function and gradient descent for binary classification.<br>. Implement a basic text classifier using Naive Bayes with manual probability calculation.<br>. Simulate a simple decision tree using if-else logic for classifying small structured data. | 4 |
| **Module 4: Clustering, Evaluation, and Regularization**<br>**Topics: Clustering (K-Means), model evaluation, bias-variance, regularization**<br>. Implement K-Means clustering using NumPy with random initialization and centroid updates.<br>0. Manually compute confusion matrix, accuracy, precision, and recall from given predicted and actual labels.<br>1. Implement Ridge Regression using the normal equation with an L2 regularization term. | 4 |
| **Module 5: Artificial Neural Networks**<br>**Topics: Perceptron, forward pass, backpropagation, RNN** | 4 |



| | |
|---|---|
| 2. Implement a single-layer perceptron for binary classification using NumPy.<br>3. Simulate forward propagation and backpropagation of a feedforward neural network with one hidden layer. | |

**TEXTBOOKS:**

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron.
2. C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide forData Scientists by Andreas.

**Gaps in the Syllabus (tomeetIndustry/Profession requirements)**

1. Industry oriented projects.

**POsmetthrough Gapsin theSyllabus** –PO2, PO4

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. AnalysisofTimeseriesdataandStreamdata.

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**–PO4

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 1 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 |

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**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD5,CD8,CD9 |
| CD2 | Tutorials/Assignments | CO2 | CD5,CD9 |
| CD3 | Seminars | CO3 | CD5,CD9 |
| CD4 | Mini Projects/Projects | CO4 | CD5,CD6,CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD5,CD6,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25306** |
| **CourseTitle** | | **:COMPUTER GRAPHICS LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Computer Graphics** |
| **Credits: 1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **03**
**Class** **: BCA**
**Semester/Level** **: V/3**
**Branch** **: Bachelor ofComputer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Learn computer graphics by practical. |
| B. | Learn to code for various graphics tools. |
| C. | Learn the various theory by implementation using programming. |
| D. | Identify the limitations of C Language for graphics-related problems. |
| E. | Know the practical application of computer graphics. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Code programs efficiently. |
| CO2 | Translate the graphics algorithm to programs. |
| CO3 | Test and execute the graphical syntax and logical errors. |
| CO4 | Apply programming to solve simple graphical problems using functions. |

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| | |
|---|---|
| CO5 | Write the C program efficiently for transformation problems. |

**Syllabus**

**List of Programs as Assignments:**
**Write a program**

1. To get the background color.
2. To set the background color.
3. To plot a point of co-ordinate (100,100).
4. To draw a line using the linefunction.
5. To draw a line using the line function.take the end coordinates from the user.
6. To draw a triangle using the polygon function.
7. To draw a polygon of‘n’edges using the polygon function.
8. To draw a polygon of‘n’edges taken from the user using the polygon function.
9. To drawa circle using the circle function.
10. To draw a circle of radius‘r’taken from the user using the circle function.
11. To draw a line using the DDA algorithm.
12. To draw a line using Bresenham’s line algorithm.
13. To draw a circle using the mid point circle algorithm.
14. To draw a line using Bresenham’sline algo, where end points are taken from the user.
15. To draw a line using DDA algo, where end points are taken from the user.
16. To draw‘n’concentric circles taken from the user using the mid point algorithm.
17. Write a program to implement polygon filling.
18. To create a line and increase its sizewith avalue taken from the user.
19. To create an equilateral triangle.
20. To draw a line and rotate it with an angle of 45.
21. To create a circle and translate it.
22. To create a circle and translate it with a value taken from the user.
23. To create an equilateral triangle and rotate it with an angle of 45.
24. To create an equilateral triangle and create reflection.
25. To scale a rectangle.
26. To shear a rectangle, take the shear factor from the user.
27. To create an equilateral triangle and translate, rotate,and scale it.
28. To draw a line with shear and translation.

**TEXT BOOKS:**

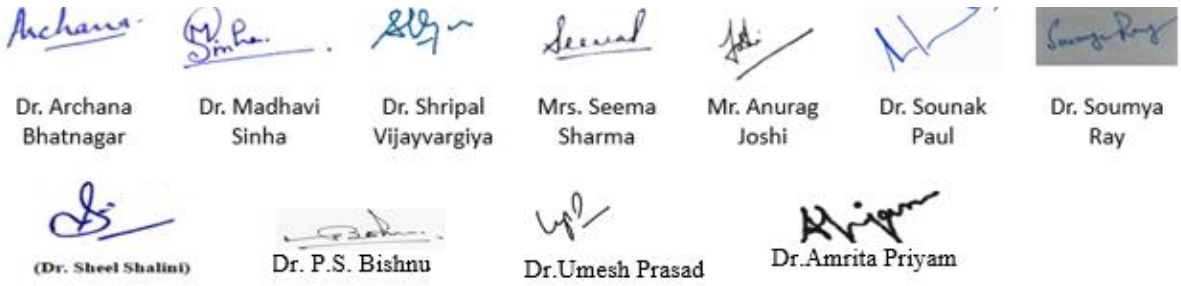

1. D. Hearnand M.P.Baker,“Computer Graphics: C Version”,2nd Edition, Pearson Education, 2013.
2. Roger T.Stevens, Advanced Graphics Programming in C and C++, BPB Publication


**REFERENCE BOOKS:**


1. Foley J.D. Dam A.Van, Feiner S.K.,and Hughes.F.,“Computer Graphics:Principles and Practice in C”, 3rd Edition, Pearson Education, 2013.
2. S. Harrington -Computer Graphics- A Programming Approach, McGraw Hill Publication, New Delhi, 1994.
3. J.D.Foleyet. al-AFundamental of Computer Graphics Addition Wesley, London,1993


**Gaps in the Syllabus (to meet Industry/ Profession requirements)**

**POs met through Gaps in the Syllabus**



**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day to day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1: Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between Cos and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1, CD8 |
| CD2 | Tutorials/ Assignments | CO2 | CD1, CD8, CD9 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/ Projects | CO4 | CD1, CD5, CD8, CD9 |
| CD5 | Laboratory Experiments/ Teaching Aids | CO5 | CD1, CD2, CD9 |
| CD6 | Industrial/ Guest Lectures | | |
| CD7 | Industrial Visits /In-plant Training | | |

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| | | | |
|---|---|---|---|
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25308**<br>**:WEB PROGRAMMING LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Web Programming** |
| **Credits:1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **: 03**
**Class** **: BCA**
**Semester/Level** **: V/3**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Learn about basics of web programming skills. |
| B. | Learn HTML, Java Script, XML for scripting. |
| C. | Learn server sideweb-based programming using ASP.NET. |
| D. | Learn Server Side Scripting using PHP. |
| E. | Learn Making static and dynamic websites using PHP or ASP.NET |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Know the fundamentals of web programming. |
| CO2 | Identify .NET technology and framework. |
| CO3 | Elaborate on the web-based programming. |
| CO4 | Perform web-based programming. |
| CO5 | Design static and dynamic websites. |

**Syllabus**

**List of Programs asAssignments:**

1. Write HTML code to develop a Web page having the background in red and title “My First Page” in any other colour.
2. Create a page to show different attributes of Font tag.
3. Create a page to show different attributes: italics, bold, underline
4. Design a page having background colour yellow, giving text colour red and using all the attributes of font tab.
5. Write an HTML code to create a Web page of blue color and display links in red colour.
6. Create a Web page using href attribute of anchor tag & the attribute: alink, vlink etc.
7. Write HTML code to create a Web page of pink colour and display a moving message in red colour.
8. Create a Web page, showing an ordered list of the names of five of your friends.
9. Create a web page, showing an unordered list of names of five of your friends.
10. Write a JavaScript code to accept radius & display the area of the circle.

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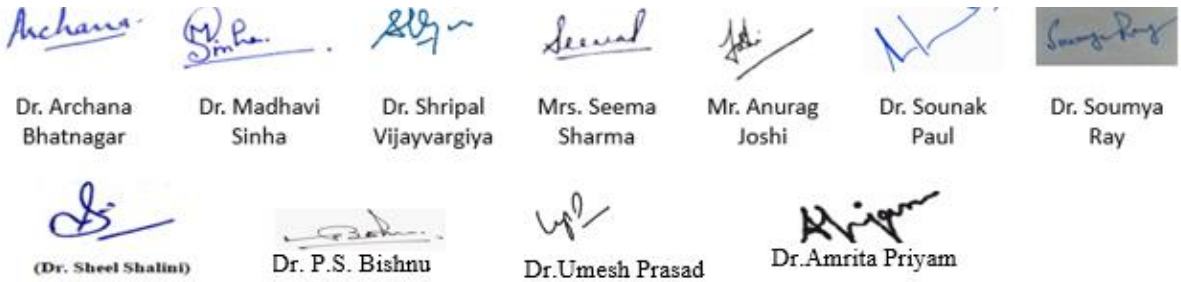
11. Use the date function get Date & set Date to prompt the user for an integer b/w 1 – 31 & return day of the week it represents.
12. Display time and print message accordingly e.g., 'Good Morning' in Morning etc.
13. Design simple HTML pages to illustrate Ordered, Unordered¬ & Definition Lists Tables¬ Frames¬ Form elements¬
14. Web page validation using Java script.
15. Create web page using CSS.
16. Event handling using DHTML.
17. Demonstrate the significance of cookies using PHP.
18. Develop a home page for a website using PHP.
19. Demonstrate Constructor Overloading.
20. Demonstrate Method Overloading.
21. Demonstrate Method Overriding.
22. Demonstrate Multilevel Inheritance.
23. Create a web page to demonstrate server controls in asp.net.
24. Demonstrate validation controls in asp.net.
25. Develop web application to view and update data in database.
26. Develop web application to insert data in to database.
27. India is a large country. Different regions observe variations in climate. The spoken language of one state is quite different from that of another. They wear different types of garments. They celebrate different festivals and perform varied religious rites. People belonging to diverse cultures belong to different religious faiths. In spite of these diversities, Indians feel a sense of unity and oneness among them. Thus, we conclude that India is a land of Unity in Diversity.

a) All the headings should be H2 and green colour.
b) Main heading should be H1 and centre aligned.
c) The background should be yellow colour.
d) There are 10 paragraphs so each of them should be made using P tag.
e) The Introduction and Conclusion paragraphs should have "Times New Roman" font, the size should be 12 and colour should be blue.
f) All the remaining paragraphs text should be pink and magenta coloured in an alternate way.

28. Create a webpage having a list as shown below: • Food. Fruit Apple Mango *Vegetable Potato Tomato Carrot • Dress Ethnic wear Kurta Sherwani Western wear suit jeans • Sports a. Indoor sports carom table tennis b. Outdoor sports Cricket Hockey
29. Create a webpage with the following: a) A superscript and subscript tag b) Pre tag c) Paragraph tag d) Anchor tag Page 91 of 243 e) Image tag f) Definition list tag g) Marquee tag h) Horizontal line tag i) Break tag j) Heading tag
30. Create a webpage having 10 divisions each having separate background color and text color using tag. At the top right corner there should be an image hyperlink opening in a new webpage. 5. Create a webpage with a form loaded into it and take input of three strings through three textboxes and then concatenate them without using any built-in function.
31. Create a webpage with two tables. First one should have 1 row and 5 columns and the second one with 3 rows and 4 columns. The contents of the first table should be center aligned and contents of the second table should be right aligned. Each column of the first table should have separate colors and each row of the second table should have separate colors.
32. Write a JavaScript program to calculate and display the aggregate and percentage of three subjects' (Physics, Chemistry and Mathematics) marks along with the name of a student. The name and individual marks input shall be taken by textbox in the webpage.
33. Write a JavaScript program to search the element 4 in the array [2, 6, 4, 10, 4, 0, -2] using any method.
34. Create a framed webpage with different frames as below: 1 2 3 4 5 6 7 8 Contents of 1st, 3rd, 5th, 7th frame should be same again 2nd, 4th, 6th and 8th should be same.
35. Write a JavaScript program to calculate the percentage of three subjects' (English, Mathematics, and Science) marks along with the name of a student. The name and individual marks input shall be taken by form in the webpage.
36. Create a webpage to take input of two strings and concatenate them without using any builtin function.



37. Write a JavaScript program to calculate and display the aggregate and percentage of three subjects' (Physics, Chemistry and Mathematics) marks along with the name of a student. The name and individual marks input shall be taken by textbox in the webpage**.**

**TEXT BOOKS:**

1. Bai Xue, Ekedahl Michael, Farrell Joyce, Gosselin Don, Zak Diane, Kaparthi Shashi, MacintyrePeter, Morrissey Bill, "The Web Warrior Guide to Web Programming", India Edition, Thomson Education.
2. XavierC.,"WebTechnology&Design",NewAgeInternationalPublishers,1stEdn,NewDelhi.

**REFERENCE BOOK**

1. Ross Ivan Bay, "Web Enable Commercial Application Using HTML, DHTML", BPB Publication.

**Gaps in the Syllabus (to meet Industry/ Profession requirements)**

1. DetailedlearningofHTMLandXHTML
2. Detailedlearningof JavaScript
3. DetailedlearningofXML

**POs met through Gaps in the Syllabus** 3, 4, 12

**Topics beyond syllabus/ Advanced topics/ Design**

1. Concepts of XSLT
2. Knowledge about Active Server Pages
3. Designing interactive server pages

**POs met through Topics beyond syllabus/ Advanced topics/ Design-**2, 3, 4, 12

**CourseOutcome(CO)AttainmentAssessmentTools& Evaluation**

**Direct Assessment**

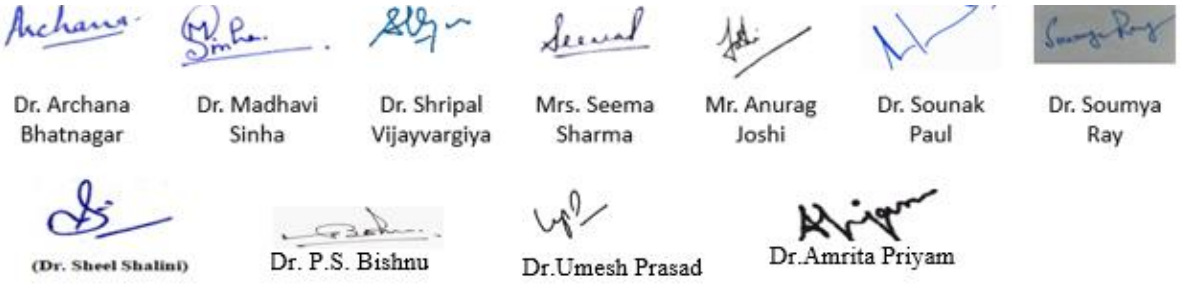
| Assessment Tool | % Contribution during COA ssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day to day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |



| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 3 |
| **CO4** | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between Cos and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture byuseofBoards/LCDProjectors | CO1 | |
| CD2 | Tutorials/Assignments | CO2 | |
| CD3 | Seminars | CO3 | |
| CD4 | Mini Projects/Projects | CO4 | |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

**SEMESTER VI**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25331**<br>**:ADVANCED JAVA PROGRAMMING** |
| **Pre-requisite(s)** | | **:Java Programming** |
| **Co-requisite(s)** | | **:Advanced JavaProgrammingLab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Build GUI interfaces for user interaction. |
| B. | Connect database with front end applications. |
| C. | Understand various mechanisms to apply constraint in the applications. |
| D. | Explain the existing classes and objects/groupof objects. |
| E. | Build different applications. |

**Course Outcomes**
After the completion of this course,students will be able to:

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| | |
|---|---|
| CO1 | Construct different applications usingSwing. |
| CO2 | Connect the database to build front end-back end based applications. |
| CO3 | Incorporate constraints and conditional statements using JSP. |
| CO4 | Encapsulate many objects into a single object. |
| CO5 | Extend the capabilities of servers that host applications accessed by means of arequest-response programming model. |

**Syllabus**

| MODULE | (NO.OF LECTURE HOURS) |
|---|---|
| **Module1**<br>Swing: Origin, Basics concepts of AWT, Two key swing features, The MVC connection, ComponentsandContainers, TheSwingpackages, EventHandling, Create a Swing Applet, Painting in Swing. | **8** |
| **Module2**<br>ExploringSwing:JLabelandImageIcon,JTextField,TheSwingButtons, JTabbedPane, JScrollPane, JList, JComboBox<br>JDBC: Introduction, JDBCDriver, DatabaseConnectivity, Access with and without DSN. | **8** |
| **Module3**<br>JSP:LifecycleofJSP,JSPAPI,JSPScriptingelements:Scriplettag,Expression tag, Declaration tag, Use of Implicit Objects: JSP Request, JSP Response, JSP Config, JSP Session, JSP Exception, JSP Directive elements | **8** |
| **Module4**<br>Java Beans: Advantages of Java Beans, Introspection-Design patterns for properties and events, Methods, use of the BeanInfo Interface, Bound and Constrained properties, Persistence, Customizers<br>Java Beans API: Introspector, PropertyDescriptor, EventSetDescriptor, MethodDescriptor | **8** |
| **Module5**<br>Servlets: Background, The life cycle of Servlet, Servlet Development options, Using Tomcat, The Servlet API, using Cookies, Session Tracking | **8** |

**TEXTBOOKS:**

1. Herbert Schildt,Java-TheCompleteReference, NinthEdition,Oracle Press.

**REFERENCEBOOKS:**

1. Uttam Roy, ADVANCED JAVAPROGRAMMING, Oxford University Press.

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**Gaps in the Syllabus(tomeetIndustry/Professionrequirements)**

**POs met through Gaps in the Syllabus**

**Topics beyond syllabus /Advanced topics/Design**

1. Implementation of frontend-backend based applications

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**PO2, PO3, PO4, PO11

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 1 |
| CO2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| CO3 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| CO4 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| CO5 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD4 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD4, CD5 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1 |

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| | | | |
|---|---|---|---|
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD4, CD5 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25333** |
| **CourseTitle** | | **:DATA ANALYTICS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:DataAnalyticsLab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand business intelligence and data analytics. |
| B. | Understand the methods of pre-processing data and performing activates related to data analytics. |
| C. | Know the various applications of data analysis. |
| D. | Know the business data analysis through the powerful tools of data analytics. |
| E. | Choose data analysis techniques. |

**CourseOutcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Illustrate about business intelligence and data analytics. |
| CO2 | Explore different aspects of data analysis technologies. |
| CO3 | Elaborate the methods of data mining and creation of decision tree. |
| CO4 | Implement data analysis through the powerful tools of data application. |
| CO5 | Apply R to implement various data analytic smethods. |

**Syllabus**

| **MODULES** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **Module1**<br>Introduction to data analytics and its applications,Overviewofthedataanalytics process.useofprogramminglanguagesandtoolsfordataanalytics,Analysisusing DescriptiveandPictorialStatistics:mean,median,mode,harmonicmean,geometric mean,varianceandstandarddeviation,quantiles,skewness,momentsandkurtosis. | **8** |
| **Module2**<br>Data Relationships, Transformation, and Data Cleaning: Relationships between different typesof data: Relationship between two categorical data,Relationship betweencategoricalandquantitativedata,Relationshipbetweentwoquantitative data Transformation: The logarithm transformation, Root and square root transformationStandardization(Z-transformation),Min-maxnormalization.Data cleaning:missingvalues,noisydata. | **8** |
| **Module3** | **9** |
| AnalysisusingInferentialStatistics: Sampling, SamplingDistribution,and Estimation ofParameters,Samplingdistributionof:means,proportions,differenceofmeans, difference of proportions.Hypothesis testing about: population mean,the difference between two means, about a population proportion, difference between two proportions. | |
| **Module4**<br>AdvancedTopicsinDataAnalytics:Time series analysis and forecastingTextmining, Text data analysis and informational retrieval. Dimensional reduction for text. Natural language processing, Social network analysis, Mining on social networks, Characteristicsofsocialnetwork,Link miningTasks and challenges. | **9** |
| **Module5**<br>DataVisualization,Principles of data visualization,Visualization libraries and tools, Effectivevisualizationtechniquesfordifferentdatatypes. | **6** |

**TEXTBOOKS:**

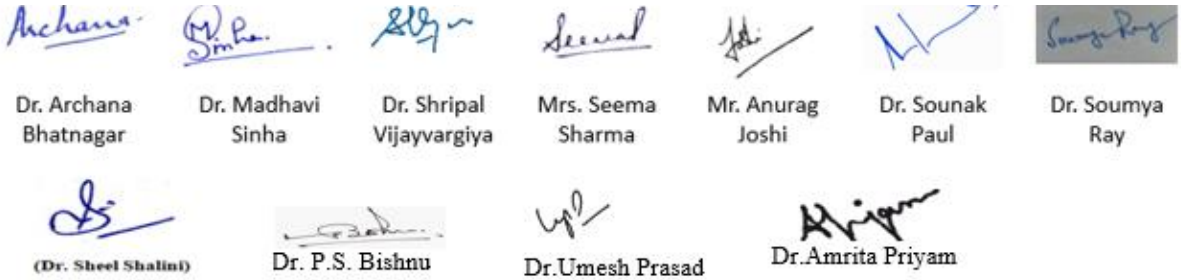

1. Gupta and Gupta,"BusinessStatistics",SultanChandandSons.
2. Bishnu and Bhattacherjee, DataAnalysis:UsingStatisticsandProbabilitywithR Language,PHILearning,2019.
3. HanJandKamberM,"DataMining:Conceptsandtechniques",MorganKaufmann Publishers.


**REFERENCEBOOKS:**


1. MaheshwariAnil,"DataAnalytics",McGrawhillpublication,2017.
2. TanPang-Ning, SteinbachMichael, and KumarVipin, "Introduction to Data Mining, PearsonEducation", New Delhi.Dunham
3. H.M.&SridharS.,"DataMining",PearsonEducation,NewDelhi,2006.


**Gaps in theSyllabus(tomeetIndustry/Profession requirements)**

1. Useofvariousdatatoimplementallthedataanalysisconcepts.
2. Interactionwithdomainknowledgeconceptswiththeactual algorithmicimplementation.



3. Handlingrealdatausingdataanalyticsalgorithms.

**POsmetthrough Gapsin theSyllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO)AttainmentAssessmentTools&EvaluationProcedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**MappingbetweenCOsandProgram Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 1 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 1 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| CO3 | 1 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 2 |

**CorrelationLevels1,2or3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD5,CD7, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD5, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5, CD8 |

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| | | | |
|---|---|---|---|
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD5, CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD2,CD3,CD4, CD6, CD7, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25335**<br>**:DISTRIBUTED COMPUTING** |
| **Pre-requisite(s)** | | **:BasicsofOperatingSystems&ComputerNetworks** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:VI /3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Know about Different forms of Computing. |
| B. | Understand Interprocess Communications. |
| C. | Learn and understand DistributedComputing Paradigms. |
| D. | Know aboutTheClientServer Paradigm. |
| E. | Implement DistributedObjects. |

**CourseOutcomes**
After the completion of this course,studentswill be able to:

| | |
|---|---|
| CO1 | Justify the presence of concurrencywithintheframeworkofdistributedsystem. |
| CO2 | Explain therangeofrequirementsthatmoderndistributedsystemsmustaddress. |
| CO3 | Describe how the resources in a parallel and distributed system are managed by software. |
| CO4 | Understand thememoryhierarchyandcost-performancetrade-offs. |
| CO5 | Explain whatvirtualizationisandhowitisrealizedinhardwareandsoftware. |

**Syllabus**

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| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1:**<br>**DistributedComputing-AnIntroduction:** Definitions, TheHistoryofDistributed Computing, Different Forms of Computing, The Strengths and Weaknesses of Distributed Computing, Basics of Operating Systems, Network Basics, Software Engineering Basics.<br>**Interprocess Communications:** An Archetypal IPC Program Interface, Event Synchronization, Timeouts and Threading, Deadlocks and Timeouts, Data Representation,DataEncoding,TextBasedProtocols,Request-ResponseProtocols, Connection-Oriented versus Connectionless IPC. | **8** |
| **Module2**<br>**Distributed Computing Paradigms:** Paradigms and Abstraction, Paradigms for Distributed Applications, Trade-offs.<br>**TheSocketAPI:**Background,TheSocketMetaphorinIPC,TheDatagramSocket API, The Stream- Mode Socket API, Sockets with Nonblocking I/O Operations, Secure Socket API. | **8** |
| **Module3**<br>**The Client-Server Paradigm:** Background, Client-Server Paradigm Issues, Software Engineering for a Network Service, Connection-Oriented and Connectionless Servers, Iterative Server, and Concurrent Server, Stateful Servers. | **8** |
| **Module4**<br>**GroupCommunication:**UnicastingversusMulticasting,AnArchetypalMulticast API, Connectionless versus Connection-Oriented Multicast, Reliable Multicasting versus Unreliable Multicasting, The Java Basic Multicast API, Reliable Multicast API. | **8** |
| **Module5**<br>**Distributed Objects:** Message Passing versus Distributed Objects, An Archetypal Distributed Object Architecture, Distributed Object Systems, Remote Procedure Calls, Remote Method Invocation, Client Callback, Stub-downloading, RMI Security Manager Advanced Distributed Computing Paradigms. | **8** |

**TEXTBOOKS:**


1. M.L.Liu,"DistributedComputing,PrinciplesandApplications",Pearson Education.


**REFERENCE BOOKS:**


1. AltiyaH.,WelchJ.,"DistributedComputingFundamentals,SimulationsandAdvanced Topics", 2nd edition, Wiley – India Edition, 2006.
2. DistributedComputing,S.MahajanandS.Shah, OxfordUniversityPress.
3. Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshema kalyani and Mukesh Singhal, Cambridge, 2010.


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**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design.**

**CourseOutcome(CO) AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels1,2or3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |

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| | | | |
|---|---|---|---|
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | | |
|---|---|---|---|
| **CourseCode**<br>**CourseTitle** | | | **:CN25337**<br>**:INTRODUCTION TO DATA MINING** |
| **Pre-requisite(s)** | | | **:DatabaseManagementSystems** |
| **Co-requisite(s)** | | | **:** |
| **Credits:3** | **L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Learn about data miningConcepts and study the different datamining tasks and issues. |
| B. | Introduction to data warehouse and basic operations for identifying similarities between data objects. |
| C. | Know the various techniques for data pre-processing. |
| D. | Familiarize the concepts of classification and clustering. |
| E. | Decide how to evaluate a model. |

**CourseOutcomes**
After the completion of this course,studentswill be able to:

| | |
|---|---|
| CO1 | Identify data mining related applications,tasksand issues. |
| CO2 | Understand the concept of data warehouse and similarity dissimilarity measures. |
| CO3 | Mathematically perform pre-processing operations on datasets to ensure thevalidity of the data is improved. |
| CO4 | Understand the algorithms of classification and clustering. |
| CO5 | Analyse and evaluate algorithms. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1:**<br>**DataMining:**Introduction, Relational Databases, DataWarehouses, Data Mining,Tools of datamining, Applications of data mining, Transactional databases, Advanced database Systems, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining. | **8** |

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| | |
|---|---|
| **Module2**<br>**Data Warehouse:** Introduction, A Multidimensional data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data warehousing to Data Mining. OLTP system, OLAP, types of OLAP, different types of schema and measures, DMQL<br>**MeasuresofSimilarityandDissimilarity**:Basics.SimilarityandDissimilaritybetween Simple Attributes. Dissimilarities between Data Objects. Similarities between Data Objects. | **8** |
| **Module3**<br>**DataProcessing**:Data Cleaning: Missing values, NoisydataData cleaning asa process. Data Integration: Entity identification problem, Redundancy detectionusing Correlation. Data Transformation: Discretization, Normalization and concept Hierarchy Generation. Data Reduction: Numerosity reduction – Histogram, clustering, sampling. | **8** |
| **Module4**<br>**Classification:** Basic Concepts and Techniques. Decision Tree Classifier. A Basic Algorithm to Build a Decision Tree. Measures for Selecting an Attribute Test Condition. Algorithm for Decision Tree Induction.<br>**Cluster Analysis:** Basic Concepts and Algorithms. Different Types of Clustering. Different Types of Clusters. K-means. Basic K-means Algorithm. | **8** |
| **Module5**<br>**ModelEvaluation:**Metrics for evaluating classifier performance, Cross-validation, ROC curve.<br>**Association Analysis**: Basic Concepts and Algorithms Preliminaries. Frequent Itemset Generation. TheApriori Principle.FrequentItemsetGenerationintheAprioriAlgorithm. Candidate Generation and Pruning Support Counting. Rule Generation. | **8** |

**TEXTBOOKS:**

1. TanPang-Ning,SteinbachMichael,andKumarVipin,"IntroductiontoDataMining", Pearson Education, New Delhi.
2. DataMining:IntroductoryandAdvancedTopics: M.H.Dunham,PearsonEducation.

**REFERENCEBOOKS:**

1. JiaweiHan&MichelineKamber-DataMiningConcepts&TechniquesPublisherHarcout India. Private Limited.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Useofmassivedatato implementallthedatamining concepts.
2. Handlingvariousdatausingsamedataminingalgorithms.

**POsmetthrough Gapsin theSyllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. TextMining,Outlier Mining
2. Advancedclusteringalgorithms

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**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 1 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25339**<br>**:INTERNET OF THINGS** |
| **Pre-requisite(s)** | | **:Computer Networks** |
| **Co-requisite(s)** | | **:InternetofThings Lab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Learn about the basic concepts of IoT. |
| B. | Learn the present state of technologyof IoT architecture. |
| C. | Get to know various types of IoT Protocols. |
| D. | Learn aboutDataAnalytics in the field of IoT. |
| E. | Learn and evaluate different applications of IoTin Smart City concept. |

**CourseOutcomes**
After the completion of this course,studentswill be able to:

| | |
|---|---|
| CO1 | Identify different parts of IoT and their uses. |
| CO2 | Explain the IoT architectures and their functions. |
| CO3 | Demonstrate the role of Wireless sensor network and Smart objects and in the field of IoT. |
| CO4 | Identify the emerging research challenges in the field of IoT. |
| CO5 | Design basic IoT application. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>What Is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and OT, IoT Challenges IoT Network Architecture and Design: Drivers behind New NetworkArchitectures,ComparingIoTarchitectures,ASimplifiedIoTArchitecture. | **9** |
| **Module2**<br>Smart Objects, The Things of IoT: Sensors, Actuators and Smart objects, Wireless Sensor Networks, Connecting Smart Objects: Communications criteria, IoT Access Technologies. | **8** |

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| | |
|---|---|
| **Module3**<br>IPastheIoTNetworkLayer: BusinessCaseofIP, NeedforOptimization, Optimizing IP for IoT, Profiles and Compliances. | **9** |
| **Module4**<br>Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods, SCADA, Generic Web-Based Protocols, COAP, MQTT, Introduction to Data Analytics for IoT, Structured and Unstructured Data, IoT Data Analytics Overview and Challenges. | **8** |
| **Module5**<br>CaseStudies/IndustrialApplications: IoTapplicationsinhome, infrastructures,buildings, security, Industries, Home appliances, other IoT electronic equipment's. | **6** |

**TEXTBOOKS:**

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, DavidHanes,GonzaloSalgueiro,PatrickGrossetete,RobBartonandJeromeHenry, Cisco Press.

**REFERENCE BOOKS:**

1. ArshdeepBahga, Vijay Madisetti,"InternetofThings(AHands-on-Approach)",University Press India Pvt. Ltd.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education (Cisco Press Indian Reprint).
3. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw-Hill Education.

**GapsintheSyllabus(to meet Industry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

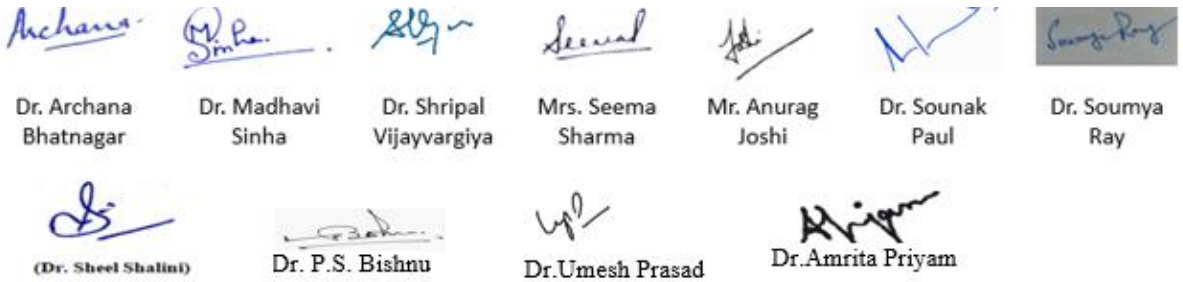
**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty



2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | ogramSpecific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25341**<br>**:OPTIMIZATION TECHNIQUES** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class scheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

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| | |
|---|---|
| A. | Understand optimization models and techniques used in solving real-world problems and acquire skills to formulate and solve linear programming problems. |
| B. | Apply the Simplex and Duality Methods to handle standard and special LPP cases |
| C. | Analyze and solve transportation and assignment problems using structured techniques |
| D. | Implement algorithms for solving network optimization problems analytical approachesand apply CPM and PERT for efficient project planning and time management. |
| E. | Develop mathematical skills to analyze and solve network models arising from a wide range of applications. |

**CourseOutcomes**

After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Understand optimization fundamentals,and the theoretical foundations of various issues related to linear programming modeling to formulate real-world problems as a LP model. |
| CO2 | Explain the theoretical workings of the graphical, simplex and analytical methods for making effective decision on variables so as to optimize the objective function. |
| CO3 | Apply appropriate methods to solve Transportation and Assignment problems |
| CO4 | Analyze network optimization models and evaluate project schedules using various techniques |
| CO5 | Appraise the need of Network Analysis, PERT and CPM. |

**Syllabus**

| MODULES | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>Linear Programming: Introduction, LP Formulations, Graphical method for solving LPs with 2 variables, Special Cases in Graphical Methods. | **8** |
| **Module2**<br>SimplexMethod,Big-Mmethod,Twophasemethod,Revisedsimplexmethod, Duality in Linear programming. | **8** |
| **Module3**<br>Dynamic Programming: Basic Concepts, Bellman's optimality principles, Dynamics programming approach in decision making problems, optimal subdivision problem. | **8** |
| **Module4**<br>Transportation Problems, Basic Feasible Solution of a Transportation Problem, Unbalanced Transportation Problem, Degenerate Transportation Problem, Assignment Problems. | **8** |

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| | |
|---|---|
| **Module5**<br>Network Analysis: Basic components of Network, Rules for drawing Network diagram Time calculation in Networks. Critical Path Method and PROJECT Evaluation and ReviewTechniques. Algorithm and flow chart forCPM and PERT. | **8** |

**TEXTBOOKS:**

1. KantiSwarup,Gupta,P.K.andManmohan,OperationsResearch,SultanChand.

**REFERENCEBOOKS:**

1. HamdyA.Taha,OperationsResearch;Pearson,10thEd.
2. OperationsResearchTheory&Application,J.K.Sharma,Macmillan,3rd Ed.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

IntegerProgrammingandNon-LinearProgammingProblemstobecoveredinAdvance Topic

**POsmetthroughGapsin theSyllabus** -3, 4, 12

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. AdvancedOptimizationTheory

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**2,3,4,12

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

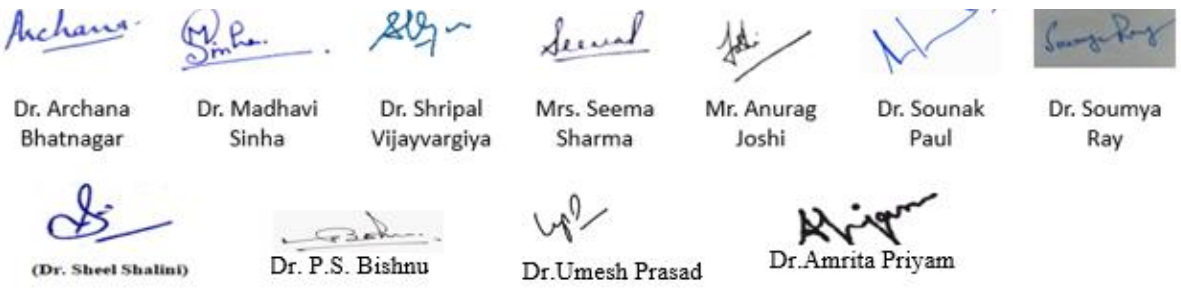
| **AssessmentTool** | **%ContributionduringCOAssessment** |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| **Course outcome** | **ProgramOutcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| **CO3** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 |
| **CO4** | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 2 |



| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD3 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN332** |
| **CourseTitle** | | **:ADVANCED JAVA PROGRAMMING LAB** |
| **Pre-requisite(s)** | | **:Java Programming Lab** |
| **Co-requisite(s)** | | **:AdvancedJavaProgramming** |
| **Credits:1.5 L:0** | **T:0** | **P:3** |

**Class schedule pe rweek** **03**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Implement GUI interfaces for user interaction. |
| B. | Apply database connectivity with frontend applications. |
| C. | Solve basic problems using JSP. |
| D. | Use existing classes and objects/group of objects for different applications. |
| E. | Design various applications using Advanced Java Programming concepts. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Implement different applications using Swing. |

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| | |
|---|---|
| CO2 | Write programs to connect the database to build frontend-backend based applications. |
| CO3 | Implement solutions of different problems using JSP. |
| CO4 | Use JavaBean for implementation. |
| CO5 | Implement client-server framework and solve different problems. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>1. Write a Swing program to create a simple login form using JLabel, JTextField, and JButton.<br>2. Create a Swing applet that displays a welcome message using the paint method.<br>3. Demonstrate the use of a container and component by placing multiple buttons in a panel.<br>4. Write a program to show the difference between AWT and Swing components using a simple form.<br>5. Create a basic GUI application using Swing that displays your name and a picture using JLabel and ImageIcon.<br>6. Implement event handling in Swing using ActionListener for button clicks.<br>7. Create a simple Swing application that uses multiple panels and layouts.<br>8. Write a Swing program that uses MVC architecture to separate logic and view. | **6** |
| **Module2**<br>1. Write a Swing program using JTabbedPane to display different content in each tab.<br>2. Create a form using JList, JComboBox, and JScrollPane.<br>3. Implement an event for a JComboBox to display selected value in a label.<br>4. Design a registration form using JTextField, JRadioButton, and JCheckBox.<br>5. Write a program to connect Java with a MySQL/Oracle/Access database using JDBC.<br>6. Develop a program to insert, update, delete, and retrieve data from a database using JDBC.<br>7. Create a login form that validates user credentials from a database using JDBC without DSN.<br>8. Demonstrate database access using a DSN in Java with MS Access. | **6** |
| **Module3**<br>1. Write a JSP program to print "Welcome to JSP" using scriptlet and expression tags. | **6** |

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| | |
|---|---|
| 2. Create a JSP page that displays current date and time using implicit objects.<br>3. Develop a registration form using JSP and display submitted data on another JSP page.<br>4. Use JSP implicit objects to get client request information (IP, browser type, etc.).<br>5. Create a JSP page to handle exceptions using isErrorPage and errorPage directives.<br>6. Demonstrate the use of declaration tag to define and call a method in JSP.<br>7. Write a JSP program to display session data like username and visit count.<br>8. Create a JSP page using directives to include a header and footer. | |
| **Module4**<br>1. Create a simple Java Bean with getter and setter methods for name and age.<br>2. Demonstrate introspection by accessing bean properties through reflection.<br>3. Write a Java Bean that raises a property change event using PropertyChangeListener.<br>4. Develop a constrained property example where change is vetoed based on conditions.<br>5. Create a bean and use persistence to save and restore the bean state.<br>6. Implement a customizer for a Java Bean to allow UI-based property setting.<br>7. Use BeanInfo interface to expose selected properties and methods of a bean.<br>**8.** Demonstrate the use of PropertyDescriptor and MethodDescriptor. | **6** |
| **Module5**<br>1. Write a simple servlet that displays "Hello from Servlet".<br>2. Create a servlet that accepts user name and password and displays it.<br>3. Develop a servlet that demonstrates request and response handling.<br>4. Implement session tracking using cookies in a servlet.<br>5. Write a servlet that counts the number of times it has been accessed using HttpSession.<br>6. Create a registration form and save the data in a database using servlet and JDBC.<br>7. Demonstrate servlet lifecycle methods: init(), service(), and destroy().<br>8. Deploy and run a servlet using Apache Tomcat server. | **6** |

**TEXTBOOKS:**

1. Gayatri Patel, Advanced JAVA Laboratory Manual, Osmora Incorporated, 2016.

**REFERENCEBOOKS:**

1. Herbert Schildt, Java - The Complete Reference, Ninth Edition, Oracle Press.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

**POs met through Gaps in the Syllabus 3, 11, 12**

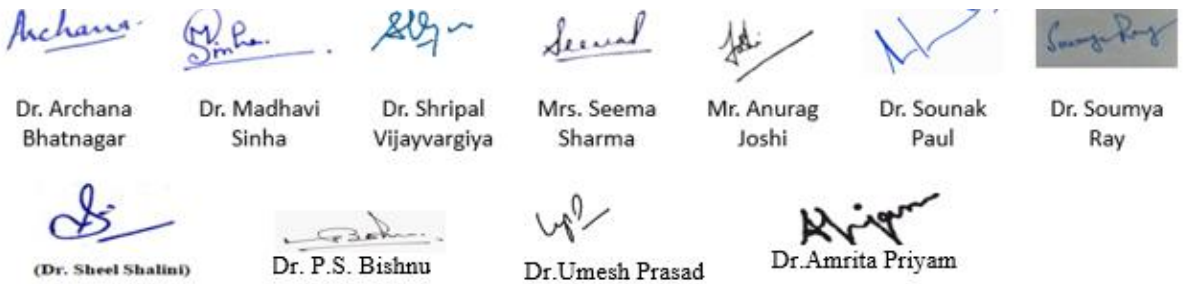
**Topics beyond syllabus/Advanced topics/Design**

1. Implementation of client-server-based applications with the support of database connectivity.

**Pos met through Topics beyond syllabus/Advanced topics/Design PO2, PO3, PO4, PO11**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**



| Assessment Tool | %Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 10 |
| Second Quiz | 20 |
| Teacher's Assessment | 30 |
| End Semester Examination | 30 |

**Indirect Assessment**

3. Student Feedback on Faculty
4. Student Feedback on Course Outcome

**Mapping between Cos and Program Outcomes**

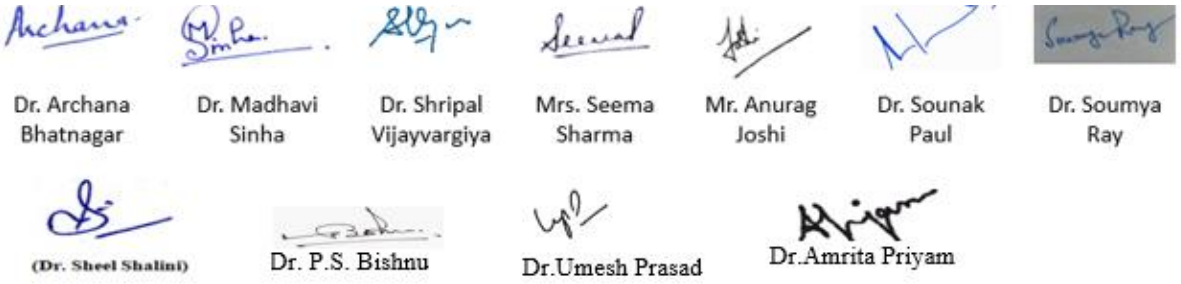
| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 |
| CO3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| CO4 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| CO5 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |

**Correlation Levels1,2or3 as defined below:**
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Mapping Between Cos and Course Delivery(CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1, CD2, CD4 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2, CD4, CD5 |
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2, CD4, CD5 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning such as use of NPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **: CN25334** |
| **CourseTitle** | | **:DATA ANALYTICS LAB** |



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| | | |
|---|---|---|
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Data Analytics** |
| **Credits:1.5 L:0** | **T:0** | **P:3** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand and apply descriptive statistical techniques and visualizations to summarize and interpret datasets. |
| B. | Explore relationships among variables and perform data cleaning and transformation for effective data preprocessing. |
| C. | Apply inferential statistical methods including estimation, hypothesis testing, and confidence intervals for decision-making. |
| D. | Analyze time series and textual data using fundamental methods of forecasting, preprocessing, and basic network analysis. |
| E. | Develop clear and insightful visual representations using standard plotting tools to communicate data-driven insights effectively. |

**Course Outcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Compute and interpret descriptive statistics and create basic visualizations to summarize dataset characteristics. |
| CO2 | Analyze relationships between variables and perform data preprocessing techniques including transformation and cleaning. |
| CO3 | Apply inferential statistical methods such as hypothesis testing, parameter estimation, and confidence interval calculation. |
| CO4 | Perform basic time series analysis, text preprocessing, and analyze structured data from social networks. |
| CO5 | Design and develop effective visualizations using appropriate tools to represent different data types and analytical results. |

**Syllabus**

| | |
|---|---|
| **Module 1: Descriptive and Pictorial Statistics**: Topics:Introduction to Python for data analytics, Descriptive statistics: mean, median, mode, variance, standard deviation, skewness, kurtosis, Visualizations: histogram, boxplot, bar chart, pie chart<br>Exercises:<br>. Load a dataset and compute mean, median, mode, and standard deviation.<br>. Calculate skewness and kurtosis of quantitative variables.<br>. Plot bar chart, pie chart, and histogram.<br>. Create boxplots to detect outliers. | **4** |

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| | |
|---|---|
| **Module 2: Data Relationships, Transformation & Cleaning:** Topics: Bivariate analysis: categorical vs categorical, categorical vs numeric, numeric vs numeric, Data transformation: log, root, square root, standardization, min-max scaling, Data cleaning: handling missing values, detecting and treating noisy data.<br>Exercises:<br>. Explore correlation between two numerical variables (scatter plot, correlation coefficient).<br>. Perform min-max normalization and Z-transformation.<br>. Handle missing values using mean/mode imputation and drop methods. | **4** |
| **Module 3: Inferential Statistics: Topics**:Sampling methods and distributions, Estimation and confidence intervals, Hypothesis testing: t-test, z-test, chi-square test.<br>Exercises:<br>. Perform one-sample and two-sample t-tests.<br>. Test population proportions and differences in proportions.<br>0. Apply chi-square test for independence on categorical data.<br>1. Create confidence intervals for population mean and proportion. | **4** |
| **Module 4: Advanced Data Analytics Topics**: Topics:Time series decomposition and forecasting, Text data analysis and preprocessing, Social network data analysis<br>Exercises:<br>2. Load and visualize time series data (trend, seasonality).<br>3. Preprocess text data (tokenization, stopword removal). | **4** |
| **Module 5: Data Visualization Techniques:** Topics: Principles of effective data visualization, Visualization tools: Matplotlib, Seaborn, Plotly, Visualizing different data types: categorical, continuous, time-series, multivariate<br>**Exercises:**<br>4. Create comparative bar charts and grouped histograms for categorical data.<br>5. Plot heatmaps to visualize correlation matrices. | **4** |

**TEXT BOOKS:**

1. RforEveryone:AdvancedAnalyticsandGraphics,BookbyJaredP.Lander
2. Python for data analysis O'Reilly Media by W. McKinney

REFERENCE BOOKS:

1. Data analysis: Using statistics and probability with R language, PHI, New Delhi by Bishnu, P. S., & Bhattacherjee, V. 2021
2. Storytelling with data: A data visualization guide for businessprofessionals. Wiley, C. N. Knaflic

**Gaps in the Syllabus (to meet Industry/Profession requirements)** **POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |

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| | |
|---|---|
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| **Course outcome** | **ProgramOutcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO2** | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| **CO3** | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| **CO4** | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels1,2or3 as definedbelow:**

1: Slight (Low) 2: Moderate (Medium) 3:Substantial(High)

**Mapping BetweenCOs and Course Delivery(CD)methods**

| **CD Code** | **CourseDeliveryMethods** | **Course Outcome** | **CourseDelivery Method Used** |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD5,CD8, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD5, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD5, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD2,CD3,CD4, CD6, CD7, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25338**<br>**:DATA MINING LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Introduction toDataMining** |
| **Credits:1.5** | **L:0T:0** | **P:3** |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Explain about the necessity of preprocessing and its procedure. |
| B. | Generate and evaluateAssociation patterns. |
| C. | Solve problems usingvarious Classifiers. |
| D. | Learn the principles of Data mining techniques and various mining algorithms. |
| E. | Learn about traditional and modern data driven approach and problem-solving techniques for various datasets. |

**CourseOutcomes**
After the completion of this course,students will be able to:

| | |
|---|---|
| CO1 | Understand Data Warehousing and Data Mining and its applications and challenges and create mini data warehouse. |
| CO2 | Apply the association rules for mining applications. |
| CO3 | Identify appropriate Classification techniquesfor various problems with high dimensional data. |
| CO4 | Implement appropriate Clustering techniques for various problems with high dimensional data sets. |
| CO5 | Implement various mining techniques on complex data objects. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>Understanding and implementation of data mining concepts using a tool. | **4** |
| **Module2**<br>Use the concepts of similarity and dissimilarity matrix to understand relationships in data. | **4** |

**TEXT BOOKS:**

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| | |
|---|---|
| **Module3**<br>Implement various data processing techniques to make raw data ready for generating accurate insights and building reliable models. | **4** |
| **Module4**<br>Implement classification and clustering algorithms. | **4** |
| **Module5**<br>Demonstrate performing association rule mining on datasets. | **4** |


1. Tan Pang-Ning, Steinbach Michael, and Kumar Vipin, "Introduction to Data Mining", Pearson Education, New Delhi.
2. Data Mining: Introductory and Advanced Topics: M.H. Dunham, Pearson Education.


**REFERENCE BOOKS:**


1. Jiawei Han & Micheline Kamber - Data Mining Concepts & Techniques Publisher Harcout India. Private Limited.


**Gaps in the Syllabus (to meet Industry/Profession requirements)**

**Pos met through Gapsin theSyllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| **CO2** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1: Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCDProjectors | CO1 | CD1, CD3 |
| CD2 | Tutorials/Assignments | CO2 | CD4, CD5 |
| CD3 | Seminars | CO3 | CD1, CD4, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD2, CD4, CD5 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD2, CD4, CD5 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25340** |
| **CourseTitle** | | **:INTERNET OF THINGS LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Internet of Things** |
| **Credits:1.5 L:0** | **T:0** | **P:3** |
| | | |

**Class schedule per week** **03**
**Class** **:BCA**
**Semester/Level** **:VI/3**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the basic concept and the IoT Paradigm. |
| B. | Know the state of art architecture for IoT applications. |
| C. | Learn the available protocols used for IoT. |
| D. | Design basic IoT Applications. |
| E. | Evaluate optimal IoT applications. |

**CourseOutcomes**
After the completion of this course,students will be able to:

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| | |
|---|---|
| CO1 | Identify the IoT Components and its capabilities |
| CO2 | Explain the concepts of the Internet of Things and gain knowledge to design IoT applications |
| CO3 | Demonstrate the process of capturing and analyzing data in the Internet of Things. |
| CO4 | Examine the various components involved in IoT design methodology. |
| CO5 | Design an IoT application |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Internetof Things ( IOT) ,Characteristics of the IOT, Communications in IoT Arduino/** Raspberry **PI in IoT.** | **4** |
| **Module2**<br>**Arduino Uno/** Raspberry **PI, Featuresof the Arduino/** Raspberry **PI, Arduino IDE (Integrated Development Environment) Installation of Arduino Software (IDE)/** Raspberry **PI installation** | **4** |
| **Module3**<br>1.Start Raspberry Pi and try various Linux commands in command terminal window: ls,cd,touch,mv,rm,man,mkdir,tar,gzip,cat,more,less,ps,sudo,cron,chown,chgrp,ping etc.<br>2. Run some python programs on Pi like:<br>a) Read your name and print Hello message with name<br>b) Read two numbers and print their sum, difference, product, and division.<br>c) Word and character count of a given string<br>d) Area of a given shape (rectangle, triangle, and circle) reading shape and appropriate values from standard input. | **4** |
| **Module4**<br>Practical 1 .Controlling the Light Emitting Diode (LED) with a push button.<br>Practical 2<br>Interfacing the RGB LED with the Arduino<br>Practical 3<br>Controlling the LED blink rate with the potentiometer interfacing with Arduino<br>Practical 4<br>Detection of the light using photo resistor | **4** |

**TEXT BOOKS:**

1. Internet of Things with Arduino Cookbook Marco Schwartz Packt Publishing Ltd.

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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| | |
|---|---|
| **Module5**<br>Run some Python programs on Pi like:<br>a) Print a name ‘n times. Where name and n are read from standard input, using for and while loops.<br>b) Handel Divided by Zero Exception<br>c) Print current time for 10 times with an interval of 10 seconds | **4** |

2. Internet of Things: A Hands On Approach Arshdeep Bahga and Vijay Madisetti Universities Press (India) Private Limited

**REFERENCE BOOKS:**

1.Internet of Things with Arduino Blueprints Pradeeka Seneviratne Packt Publishing Ltd
2.Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD).
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

Mapping between COs and Program Outcomes

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 3 |

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**CorrelationLevels1,2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | Laboratory Experiments/ Teaching Aids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

**ANNEXURE A ARTIFICIAL INTELLIGENCE & MACHINELEARNING**
**SEMESTERVII/VIII**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25401**<br>**:DEEP LEARNING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:Deep Learning Lab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understandtheconceptsofmathematical modelling. |
| B. | ExploretheapplicationareasofNeuralNetworks. |
| C. | ExplorethebasicconceptsofFeed forwardNeuralNetworks. |
| D. | Understand the idea of Convolutional Neural Networks and Recurrent Neural Networks. |
| E. | Understand the basic component of Machine Learning. |

**CourseOutcomes**
After the completion of this course,studentswillbeableto:

| | |
|---|---|
| CO1 | Abletodifferentiatebetweenmachinelearninganddeeplearning. |

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| | |
|---|---|
| CO2 | Identifyproblemssuitableforapplicationofdeeplearning. |
| CO3 | Understandtheworking ofFFNeuralNetworksandtheirmodifications. |
| CO4 | Apply Recurrent Neural Networks to solve problems. |
| CO5 | Apply Recurrent Neural Networks to solve problems. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**From LogictoCognitiveScience:**<br>The Beginnings of Artificial Neural Networks,The XOR Problem, From Cognitive Science to Deep Learning Neural Networks in the general AI Landscape. | **8** |
| **Module2**<br>**Machine Learning Basics:** Elementary Classification Problem,Evaluating Classification Results, A Simple Classifier:Naive Bayes, A Simple Neural Network: Logistic Regression, Introducing the MNIST Dataset, Learning Without Labels: K- K-Means, Learning Different Representations: PCA, Learning Language: The Bag of Words Representation. | **8** |
| **Module3**<br>**Feedforward Neural Networks:** Basic Concepts and Terminology for Neural Networks, Representing Network Components with Vectors and Matrices, The Perceptron Rule,The Delta Rule,FromtheLogisticNeuronto Backpropagation.A Complete FeedforwardNeural Network. | **8** |
| **Module4**<br>**Convolutional Neural Networks:** A Third Visit to Logistic Regression, Feature Maps and Pooling. A Complete Convolutional Network, Using a Convolutional Network to Classify Text and Sequences of Unequal Length. | **8** |
| **Module5**<br>**RecurrentNeuralNetworks:**<br>The Three Settings of Learning with Recurrent NeuralNetworks,Adding Feedback Loops and Unfolding a Neural Network, Long Short-Term Memory. Using a Recurrent Neural Network for predictingwords. | **8** |

**TEXTBOOKS:**

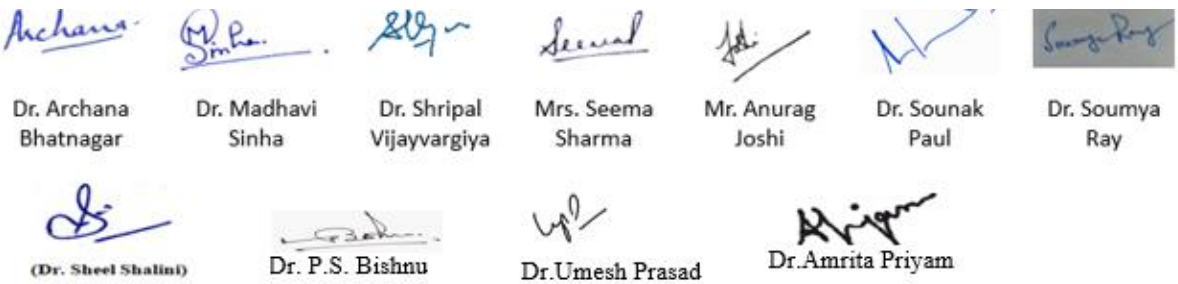
1.Skansi S., Introduction to Deep Learning -From Logical Calculus to Artificial Intelligence, Springer International Publishing.

**REFERENCEBOOKS:**

1. BudumaN.,FundamentalsofDeepLearning,OReilly Media.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Applicationofneuralnetworkindecisionmaking.
2. Applicationofdeeplearninginreallife problems.



**POsmetthrough Gapsin theSyllabus:**4,5

**Topics beyondsyllabus/Advancedtopics/Design**

1. DesignofDeepLearningbasedsystemtosolve problems.
2. CombineDeepLearningwithotherdomainstosolvecomplexsystem.

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design:**4,6,10

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | Contributionduring CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 2 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8 |
| CD3 | Seminars | CO3 | CD1,CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD2,CD4 |

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| | | | |
|---|---|---|---|
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD3,CD1 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | IndustrialVisiIn-plant Trainging | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

**CourseCode** : **CN411**
**CourseTitle** **: DATA VISUALIZATION**
**Pre-requisite(s)** **:**
**Co-requisite(s)** **:**
**Credits:4 L:3 T:1 P:0**

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Knowthebasicsofdatavisualization. |
| B. | Introduce visual perception and core skills for visual analysis. |
| C. | Translateandpresentdataanddata correlationsinasimpleway. |
| D. | Haveanunderstandingofvarioustoolsforcreatingdata visualizations. |
| E. | Learn to wisely use various visualization structures such as tables, spatial data, time-varying data, tree, and network. |

**CourseOutcomes**
Afterthe completionofthiscourse, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate understanding of Data Visualization and key Terms. |
| CO2 | Demonstrateskillsoncreatingvisualrepresentationof Data. |
| CO3 | Apply visualization techniques for various data analysis tasks. |
| CO4 | Demonstrate understanding of Visualization classification and its techniques. |
| CO5 | Demonstrates skills in creating different types of representations. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **Module1**<br>Introduction to data visualization, History of data visualization, importance of data visualization in data science, Principles of data visualization, Visual mapping and Elements of data visualization. Common tools and techniques for creating data visualizations. | **8** |
| **Module2**<br>Introduction of various charts and graphs, Design principles for charts and graphs, The do's and don'ts of charts and graphs making. The process of creating visualizations and selecting the appropriate visual display. | **8** |
| **Module3**<br>Visualizationasexploration,visualizingcategoricaldata,Visualizingtimeseriesdata, Visualizing Geospatial data, Visualizing multiple variables. | **8** |
| **Module4**<br>IntroductionofDashboarddesign,varioustypesofDashboards,Interactive visualizations, Story Telling through Data. | **8** |
| **Module5**<br>Visualization of groups, trees, graphs, clusters, networks. Data science use cases for data visualization. | **8** |

**TEXTBOOKS:**


1. Wong,D., The Wall Street Journal guide to information graphics:Thedosanddon'tsof presenting data, facts and figures. New York: W.W. Norton & Company.
2. Yau,N.,DataPoints:Visualizationthatmeanssomething.Indianapolis:O'Reilly.
3. KieranHealy,DataVisualization:APractical Introduction.


**REFERENCEBOOKS:**


1. Few,S., Information Dashboard Design:Theeffectivevisualcommunicationofdata. Sebastopol: O'Reilly.
2. Ware, C&Kaufman,M.,Visualthinkingfordesign.Burlington:MorganKaufmann Publishers.
3. Ward,GrinsteinKeim,InteractiveDataVisualization:Foundations,Techniques,and Applications. Natick: A K Peters, Ltd.


**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

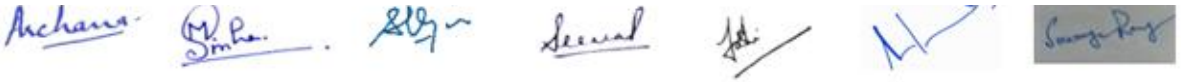
**Topics beyond syllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |



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| | |
|---|---|
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 2 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 1 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD5, CD6, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD4, CD5 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD4, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD3, CD4, CD6 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD5, CD,6, CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN402** |
| **CourseTitle** | | **:DEEPLEARNINGLAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:DeepLearning** |

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| Credits:2 | L:0 | T:0 | P:4 |
|---|---|---|---|

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | ExploreTensorFlow,Keras. |
| B. | Implementbackpropagationnetworks. |
| C. | ImplementofConvolutions networks. |
| D. | Implementfeedforwardneuralnetworks. |
| E. | ImplementationofText Classification,WordEmbeddingsandLanguageModels. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | UnderstandMLPwith Keras. |
| CO2 | ImplementBackpropagationinNeural Networks. |
| CO3 | DesignConvolutionalNeuralNetworksforImageClassification. |
| CO4 | Analyzefeed forward networks. |
| CO5 | Implement&analyzeDeepLearningforImage Segmentation. |

**Syllabus**

**ListofProgramsasAssignments:**
**Lab Assignment No: 1**
Objective:IntrotoDeepLearningNeuralNetworksand Backpropagation
Q.1 IntrotoMLPwithKeras

**LabAssignmentNo:2**
Objective:NeuralNetworksand Backpropagation
Q.1BackpropagationinNeural Networks

**LabAssignmentNo:3**
Objective:ConvolutionalNeuralNetworksforImageClassification
Q.1DesignofConvolutionsNeuralnetworkforimage classification

**LabAssignmentNo:4**
Objective:Deep Learning for Object Detection
Q.1Design of Fully Convolutional Neural Networks for object detection

**LabAssignmentNo:5**
Objective:DeepLearningforImageSegmentation
Q.1DesignofFullyConvolutionalNeuralNetworksforImage Segmentation

**TEXTBOOKS:**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

1.Deep Learning with TensorFlow 2 and Keras: Regression, ConvNets, GANs, RNNs, NLP, andmorewithTensorFlow2andtheKerasAPI,byAntonioGulli,AmitaKapoor,SujitPal.

**REFERENCEBOOKS:**

1.LearningTensorFlow:AGuidetoBuildingDeepLearningSystems,TomHope,Yehezkel S. Resheff

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**MappingofCourseOutcomesontoProgramOutcomes**

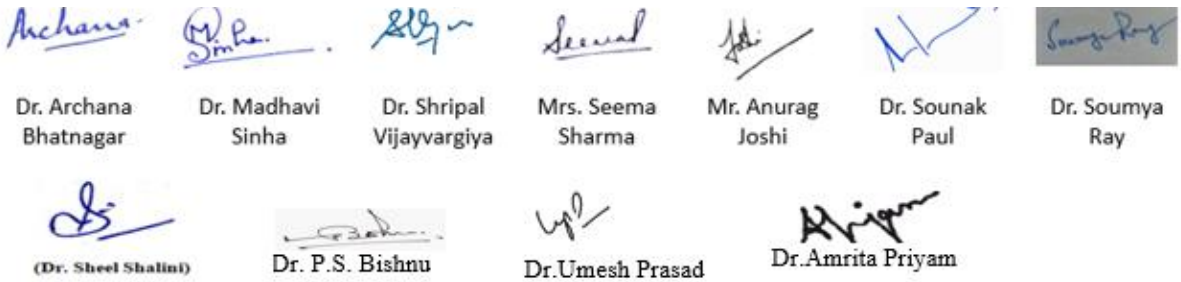
| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD5,CD9 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD5,CD9 |
| CD3 | Seminars | CO3 | CD1,CD5,CD9 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD5,CD9 |
| CD6 | Industrial/GuestLectures | | |



| | | | |
|---|---|---|---|
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN412**<br>**: DATA VISUALIZATION LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: DataVisualization** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week:04**
**Class : BCA**
**Semester/Level: VII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Interpretdataplotsandunderstandcoredatavisualizationconceptssuchas correlation, linear relationships, and log scales. |
| B. | Explore the relationship between two continuous variables using scatter plots and line plots. |
| C. | Translate and present data and data correlations in a simple way. |
| D. | Designinteractivedashboardusingtableau. |
| E. | Explore all the aspects of Tableau and for solving data visualization. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Design effective data visualizations. |
| CO2 | Find and select appropriate data that can be used in order to create avisualization. |
| CO3 | Apply visualization techniques for various data analysis tasks. |
| CO4 | Create ad-hoc reports, data visualizations, and dashboards using Tableau. |
| CO5 | Apply visualization techniques for various real-time use cases. |

**SYLLABUS**

**List of Programs as Assignments:**

1. Exploring Data Visualization Tools:Tableau, Power BI,R-Programming Language.
2. Handson with Tableau
3. Creating charts and graphs with Tableau and R.
4. Visualization of Categorical Data using Tableau and R.
5. Geospatial Data Visualization Using Tableau and R.
6. Time-SeriesDataVisualizationusingTableauandR.

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7. CreatingwordcloudusingTableauandR.
8. Design an interactive dashboard using Tableau.
9. TellingstorywithdatabyusingTableau.
10. Solve a case study which must cover all aspects of visualization.

**TEXT BOOKS:**

1. VisualAnalyticswithTableaubyAlexanderLoth,NateVogel, SophieSparkes,Wiley Publication.
2. Rfordatascience:Import,Tidy,Transform,Visualize,AndModelDatabyHadleyWickham, Garrett Grolemund.

**REFERENCE BOOKS:**

1. VisualizationAnalysis&DesignbyTamara Munzner.
2. InteractiveData VisualizationfortheWebbyScottMurray.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | Contributionduring CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 1 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 1 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 1 | 3 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 1 | 3 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1CD4,CD5 |
| CD2 | Tutorials/Assignments | CO2 | CD2,CD4,CD5 |
| CD3 | Seminars | CO3 | CD4,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD4,CD5,CD6, CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD4,CD5,CD6, CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25403** |
| **CourseTitle** | | **: DIGITAL GAMING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: Digital GamingLab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **: BCA**
**Semester/Level** **:VII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the basic concepts of Digital Games and Interactive Multimedia. |
| B. | Define the components of a game and design a concept for a Game in game design document. |
| C. | Identify various stages of the Game Production process. |
| D. | Illustrate the interactive story of a game. |
| E. | Analyze the games from the perspective of a game designer. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | AnalysetheDigitalGamesandothermediumsof Interactive Storytelling. |
| CO2 | DescribeGameDevelopmentProcessanditsvariousstages. |

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| | |
|---|---|
| CO3 | Designboardgames and documents for digital games. |
| CO4 | Createstoryandcontentofagame. |
| CO5 | CriticallyanalysethegameplayofthegamesandwillbeintroducedtoGame Engine software. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**:<br>**Understanding Games:** What is a Game,History, Game vs Books and Movies,Digital Games vs Traditional Games, Elements of Game, Game Genre. | **10** |
| **Module2**<br>**Game Development Process:** Overview of Game Development, Game Design, Pre- Pre-production, Production, Game Art and Animation, Game User Interface, Game Audio, Quality Assurance (QA) and Testing, Game Publishing and Distribution, Project Management, Ethical Considerations (Intellectual Property, Rating System, etc.) | **10** |
| **Module3**<br>**Game Design Documentation:**Game Idea Generation, What is Game Design Document, Principles of Game Design, Sample Game Design Documents, Game Design Document Template, Board Game Design | **5** |
| **Module4**<br>**Game Narrative:** Basics, Non-Linear Game Narrative / Interactive Storytelling, Character Development, Localization, Games and Culture | **7** |
| **Module5**<br>**Game Appreciation and Analysis:** Game Appreciation: Game Play sessions and Discussions, Game Analysis: Tetris and Any Current Poplar Game, Serious Games: Analyze serious games | **8** |

**TEXTBOOKS:**


1. Monograph of Story Appreciation for Gaming, Dept. of Animation and Multimedia, BIT Mesra Ranchi.
2. Monograph on Fundamentals of Game Technology, Dept. of Animation and Multimedia, BIT Mesra Ranchi.
3. GameDesignforTeensbyLesPardew,Premier Press.


**REFERENCE BOOKS:**


1. Andrew Rollings and Ernest Adams on Game Design by ARollings E Adams, NewRiders Publisher.
2. Tracy Fullerton, Game Design Workshop: A Playcentric Approach to Creating Innovative Games, CRC Press.
3. DavidNixon, Unreal Game Engine for Beginners.


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4. ChrisSolarski, Interactive Stories and Video Game Art: A Storytelling Framework for Game Design, Taylor and Francis Group.
5. Simon Egenfeldt-Nielsen et al, Understanding Video Games: The Essential Introduction, Routledge, Taylor and Francis, New York.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond the syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## CourseOutcome(CO) AttainmentAssessmentTools&EvaluationProcedure

**Direct Assessment**

| AssessmentTool | Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 1 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**CorrelationLevels1,2or3asdefined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD4,CD5, CD9 |

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| | | | |
|---|---|---|---|
| CD2 | Tutorials/Assignments | CO2 | CD1,CD6,CD8, |
| CD3 | Seminars | CO3 | CD1,CD4,CD5, CD9 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD6,CD8, |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD4,CD5, CD7, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25415**<br>**:ADVANCED PYTHON PROGRAMMING** |
| **Pre-requisite(s)** | | **:Python Programming** |
| **Co-requisite(s)** | | **:Advanced Python Programming Lab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class:BCA**
**Semester/Level** **:VII /4**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | UnderstandregularexpressionsinPython, implementing data structures in Python, Using various time functions. |
| B. | Understandtheconcepts ofthreadsinPython. |
| C. | CreateGUIusingPython. |
| D. | UnderstandNetworkingthroughPython. |
| E. | Use databases through Python,analyzingandvisualizingdatausing Python. |

**CourseOutcomes**
Afterthe completionofthiscourse, students will be able to:

| | |
|---|---|
| CO1 | Interpretregularexpressionsandvariousdatastructuresin Python. |
| CO2 | Implementtheconceptsofthreadsfordevelopingefficientprograms. |
| CO3 | DesignGUIprograms. |
| CO4 | Identifythecommonlyusedoperationsinvolvingnetworking. |
| CO5 | Applyknowledgeofdatabaseprogramminganddataanalysisin Python. |

**Syllabus**

Dr. Archana Bhatnagar, Dr. Madhavi Sinha, Dr. Shripal Vijayvargiya, Mrs. Seema Sharma, Mr. Anurag Joshi, Dr. Sounak Paul, Dr. Soumya Ray

(Dr. Sheel Shalini), Dr. P.S. Bishnu, Dr.Umesh Prasad, Dr.Amrita Priyam

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **ModuleI**<br>AbstractclassesandInterfacein Python.<br>RegularExpressionsinPython:Regularexpressions,sequencecharacters,quantifiers, and special characters in regular expressions, using regular expressions on files, retrieving information from a HTML file.<br>Date and Time in Python: Date and Time Now, Combining and formatting date and time, finding duration, comparing two dates, sorting dates, working with calendar Module.<br>DatastructuresinPython:Linkedlist,stacks,andqueues. | **8** |
| **ModuleII**<br>Threads:Multitasking,Processandthreads,concurrentprogrammingandGIL,Usesof thread, creating threads, thread class methods, thread synchronization, locks, semaphore, deadlock of threads, thread communication using notify () and wait () methods, thread communication using queue, Daemon threads. | **8** |
| **ModuleIII**<br>GUIin Python:<br>TheRootWindow,Fonts,andcolors,workingwithcontainers,canvas,frame,widgets: Button widgets, arranging widgets in the frame, Label widget, message widget, text widget,scrollbarwidgets,checkbuttonwidget,radiobuttonwidget,entrywidget,spin box widget, list box widget, menu widget, creating tables. | **8** |
| **ModuleIV**<br>NetworkprogramminginPython:<br>Sockets, knowing IP Address, URL, reading the source code of a webpage, downloadingwebpagefrominternetthroughpython,ATCP/IPServer,TCP/IPclient, File server, File client, two-way communication between server and client, sending a simple mail. | **8** |
| **ModuleV**<br>DatabaseprogrammingusingPython:<br>Advantage of DBMS over Files, Using MySQL from Python, Creating and manipulating tables through Python.<br>Data Analysis using Python: Series, Data Frame, creating data frames, operations on data frames. Data visualization: Bar graph, Histogram, pie chart, line graph. NumPy Library. | **8** |

**TEXTBOOKS:**


1. CorePythonProgrammingbyDr.RNageswara Rao,DreamtechPressIndia.
2. Python:TheCompleteReferencebyMartinC.Brown,McGrawHillEducation.


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**REFERENCEBOOKS:**

1. ProgrammingPython:PowerfulObject-OrientedProgramming, MarkLutzO'reilly.
2. ThinkPython,byAllenB.Downey,O'reilly.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. ImageprocessingwithPython

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-PO3,PO5

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |

**CorrelationLevels1,2or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COsand CourseDelivery(CD)methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards /LCD Projectors | CO1 | CD1,CD2,CD4, CD5 |
| CD2 | Tutorials/ Assignments | CO2 | CD1,CD2,CD3, CD4, CD5, CD8 |

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| | | | |
|---|---|---|---|
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD4, CD5, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD3, CD4, CD5 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD3, CD4, CD5, CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25404**<br>**:DIGITALGAMINGLAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:DigitalGaming** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | FamiliarizestudentswiththeUnrealEngineinterface, tools, and features, providing a foundation for working with the engine. |
| B. | Understandthefundamentalconceptsofgamedevelopment, including gamedesign principles, mechanics, and gameplay elements. |
| C. | Explore how to build 3D game environments using Unreal Engine, including level design, terrain creation, lighting, and asset placement. |
| D. | Implement the core game mechanics, such as player movement, physics, collision detection, and interactive elements. |
| E. | Understand Blueprint scripting, Unreal Engine's visual scripting system, enablingthem to create gameplay logic, AI behaviors, and interactions. |

**CourseOutcomes**
Afterthe completionofthiscourse,students will be able to:

| | |
|---|---|
| CO1 | DesignGameLevelsusingUnrealGame Engine. |
| CO2 | ExplorethepotentialofGameandInteractiveApplicationDevelopmentin upcoming fields like Augmented Reality, Virtual Reality and Mixed Reality. |
| CO3 | Understandtheprocessoftesting,debugging,andrefiningtheirgamestoimprove gameplay experience and address issues. |

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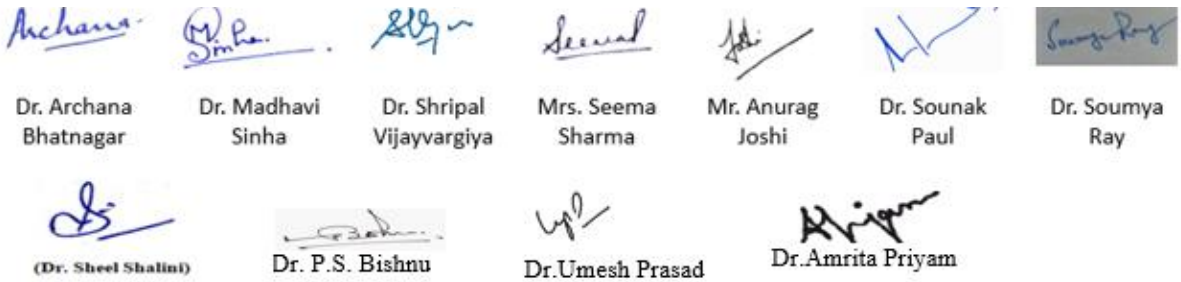
| | |
|---|---|
| CO4 | Understandtheprojectmanagementmethodologiesspecifictogamedevelopment /MultimediaProject. |
| CO5 | Package and deploy their games for various platforms, such as PC, consoles, or mobile devices, and create a final showcase of their work. |

**Syllabus**

**ThefollowingexercisearedesignedforUnreal GameEnginebutcanbedoneinanycurrent prevalent Game Engines:**

1. Installing the Game Engine and Understanding the interface of the game engine (UnrealEditor) software and Demo of sample game
2. Creating,OpeningandSavingtheGameLevels
3. PlayingaGame Level
4. UnderstandingActorsandusingthem>StaticMeshActor&Material
5. UnderstandingActors>Light&GeometryBrushes
6. Viewport Navigation in 3D space: mouse navigation, WASD navigation, Focusing, Maya Navigation, Camera Speed Level Editor Overview: What is the difference between the Unreal Engine and the Unreal Editor.ThedifferentpartsoftheLevelEditor-Viewport,Toolbar,ContentBrowser,Bottom Toolbar, Outliner, and Details Panel. How to customize the interface.
7. Viewport II – Moving, Rotating, and Scaling: How to use the translation, rotation, and scaling widgets. How to select multiple Actors and move them all at once. How to copy Actors. How to change the pivot point of an Actor. What is the difference between world space vs local space.
8. Viewport–Snapping:HowtousesnappingtoperfectlyalignyourActors withoneanother within your Level. What is the difference between Surface Snapping, Grid Snapping, RotationSnapping,ScaleSnapping,andVertexSnapping.The"RotatetoSurfaceNormal" and "Surface Offset" settings. What are snap sizes.
9. ViewportIV–DifferentWaysToViewYourLevel:WhatisImmersiveMode.Whatisthe difference between the View Modes - Lit, Unlit, and Wireframe. What is the difference betweenaperspectiveviewandanorthographicview.TheShowFlagssetting,GameView, and piloting Actors within the Viewport. The Viewport Options menu including Realtime, ShowFPS,ShowStats,ShowToolbar,FieldOf View,FarViewPlane,ScreenPercentage, and Bookmarks.
10. Content Browser I - Overview & Finding Content: The Sources Panel, Asset Window, Collections Panel, searching the Content Browser, and breadcrumbs. The Content Drawer, Dock in Layout button and search filters. What is the difference between static collections vs dynamic collections.
11. The Add New, Import, and Save All buttons of the Content Browser. How to use the "Add Feature or Content Pack" feature. How to migrate assets in Unreal Engine.
12. Actors>AtmosphereandClouds,PlayerStart,Components,Volumes
13. Exercise:CreatingMaterial
14. Exercise:CreatingtheSky
15. Exercise:CreatingthePlayingArea:Constructtheplayingareaforourgame,usingBrushes, Meshes, and Materials.
16. Exercise:Addtheinternalstructuresforour Level,includingwalls,platforms,andhouses.
17. Introductionto Blueprints
18. Exercise: Use Blueprints to create our first custom Actor - a platform that will continually move up and down.
19. Exercise:UseBlueprinttocreatethe enemies
20. Exercise:useBlueprinttocreatetherotatingDoor
21. Exercise:CreateDestructibleMesh
22. Exercise:Createa Terrain
23. Exercise:CreateaPlayable Character
24. Collisions:Exercise:HowtousecollisionvolumessuchasaBoxCollision,Capsule Collision, or Sphere Collision.



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25. Emitters:Exploringvarioustypesof emitters
26. Exercise:CreatingEmitters
27. Exercise:Addingaudiointhegame
28. Exercise:UserInterface:CreatingHUD,DamageTintandCollectItemTint,RestrictDoor Opening and Creating a Pause Menu, Game Over and Win Screen Menu etc.
29. Exercise:PackagingtheGameforvariousplatforms

**TEXT BOOKS:**

1. "UnrealEngine4forBeginners"byDavidNixon

**REFERENCE BOOKS:**

1. "Unreal Engine 4 Game Development in 24 Hours" by Aram Cookson and Ryan Dowling Soka
2. "UnrealEngine4GameDevelopmentEssentials" bySatheeshPV
3. "LearningUnrealEngineGameDevelopment"byJoannaLeeandRichardA.Hawley
4. "MasteringUnrealTechnology:TheArtofLevelDesign"byJasonBusbyandZakParrish

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Exposuretoothergameenginesuchas Unity.

**POsmetthrough Gapsin theSyllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | Contributionduring CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| **CO4** | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD4,CD5,CD8, CD9 |
| CD2 | Tutorials/Assignments | CO2 | CD5,CD6, |
| CD3 | Seminars | CO3 | CD5,CD6, |
| CD4 | Mini Projects/Projects | CO4 | CD5,CD6, |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD4,CD5,CD7, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | : **CN25416** |
| **CourseTitle** | | **:ADVANCED PYTHON PROGRAMMING LAB** |
| **Pre-requisite(s)** | | **:Python Programming** |
| **Co-requisite(s)** | | **:Advanced Python Programming** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | UseregularexpressionsinPython,implementingdatastructuresinpython,using various time functions. |
| B. | Implementthreadsin Python. |
| C. | CreateGUIprogramsinPython. |
| D. | Networkingprogrammingthrough Python. |
| E. | CreateandmanipulatedatabasesinMySQLthroughPython.UsingNumPyandPandas to analyze and visualize data. |

**CourseOutcomes**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Implementvariousdatastructuresusing Python. |
| CO2 | Implementtheconceptsofthreadsina program. |
| CO3 | CreateGUI programs. |
| CO4 | Implementnetworkingthrough Python. |
| CO5 | Store,retrieve,manipulateusingMySQLinPython.Analyzingandvisualizingdata. |

**Syllabus**

**ListofProgramsasAssignments:**

1. Implementstackdatastructure.
2. ImplementQueueData structure.
3. ImplementLinkedlist.
4. WritePythonprogramtofindthedayoftheyear and theweekday name.
5. WritePythonprogramtoaccept adate fromthekeyboardanddisplay the dayoftheweek.
6. WritePythonprogramtofindfuturedate andtime fromanexistingdate&time.
7. WritePythonprogramtogeneraterandomnumbersinarangewithsometimedelay between each number.
8. Aprogramtofind thecurrentlyrunningthread inaPython program.
9. WritePythonprogramtopassargumentstoafunctionandexecuteitusingathread.
10. WritePythonprogramtocreateathreadbymakingourclass assubclasstothread class.
11. WritePythonprogramtocreateathreadthataccessestheinstancevariablesofaclass.
12. Write Python program to create a thread that acts on the object of a class that is not derived from the thread class.
13. Write Python program to showsing let asking using a thread.
14. WritePythonprogramto performtwotasksusing twothreadssimultaneously.
15. WritePythonprogramwherethreadsareactingonthesamemethodtoallotaberthforthe passenger.
16. WritePythonprogramachievingthreadsynchronizationusinglocks.
17. WritePythonprogramtodemonstratedeadlockof threadsduetolocksonobjects.
18. WritePythonprogramwherethreadcommunicationisdonethroughnotify()andwait().
19. WritePythonprogramwherethreadcommunicationisdoneusingqueue.
20. WritePythonprogramto createadaemonthread.
21. WritePythonprogramtodrawvariousshapesincanvas.
22. WritePythonprogramto displayimagesinthecanvas.
23. WritePythonprogramtodisplaydrawinginthe canvas.
24. WritePythonprogramtocreateatextwidgetwithaverticalscrollbrattachedtoit.
25. WritePythonprogramtocreatehorizontalscrollbarandattachittoatextwidgettoview the text from left to right.
26. WritePythonprogramtocreatefourcheckbuttonsandknowwhichoptionsareselected by the user.
27. WritePythonprogramtocreatetworadiobuttonsandknowwhichoptionisselectedby the user.
28. WritePythonprogramtocreateEntrywidgetsforenteringusernameandpasswordand display the entered text.
29. WritePythonprogramtocreatetwospinboxesandretrievedthevaluesdisplayedinthe spin boxes when the user clicks on a push button.
30. WritePythonprogramtocreatealistboxwithcoursenamesanddisplaywhichcoursesare selected by user.
31. AGUIprogramtodisplayamenuandtoopen afileandsaveitthroughthefiledialog box.
32. WritePythonprogramtocreateatablewithfourrowsandthree columns.
33. WritePythonprogramto findthe IPaddressof a website.
34. Apythonprogramtoretrievedifferentpartsofthe URLanddisplay them.

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35. WritePythonprogramtoreadsourcecodeof aweb page.
36. WritePythonprogramtodownloadawebpagefrominternetandsaveitintoour computer.
37. WritePythonprogramto downloadanimagefromtheinternet.
38. WritePythonprogramtocreateaTCP/IPserverprogramthatsendsmessagestoa client.
39. WritePythonprogramtocreateaTCP/IPclientprogramthatreceivesmessagesfromthe server.
40. WritePythonprogramtocreateabasicchatserverprogramin Python.
41. WritePythonprogramtocreateabasicchatclientprograminPython.
42. WritePythonprogramtosendemailtoanymailaddress.
43. WritePythonprogramtoretrieve anddisplayallrowsofemptableinmysql.
44. WritePythonprogramtoinsertnrowsintoatable inMysql.
45. WritePythonprogramto createstudenttable(name,roll,coursenameandage)inmysql.
46. WritePythonprogramto retrievestudent'sinformationbyenteringhisrollnumber.
47. Createdataframeusing csvfile.Retrievethedata throughdataframe.
48. WritePythonprogramtodisplaystudentsrollnumberonx-axisandtotalmarksony-axis in the form of a bar graph.
49. WritePythonprogramtocreatelinegraph toshowyear wiseprofitof acompany.
50. WritePythonprogramtodisplayapiechartshowingthepercentageofemployeesineach department of a company.

**TEXT BOOKS**

1. CorePythonProgrammingbyDr.RNageswara Rao,DreamtechPressIndia.
2. Python:The Complete Reference by Martin C.Brown, McGraw Hill Education.

**REFERENCE BOOKS**

1. Programming Python: PowerfulObject-Oriented Programming by Mark Lutz.
2. Think Python by Allen B. Downey.

**Gaps in the Syllabus (to meet Industry/Profession requirements)**

1. Seaborn libraries and web scrapping module Beautiful Soup

**POsmetthrough Gapsin theSyllabus** -PO3, PO5

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. ImageprocessingwithPython

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**PO3,PO5

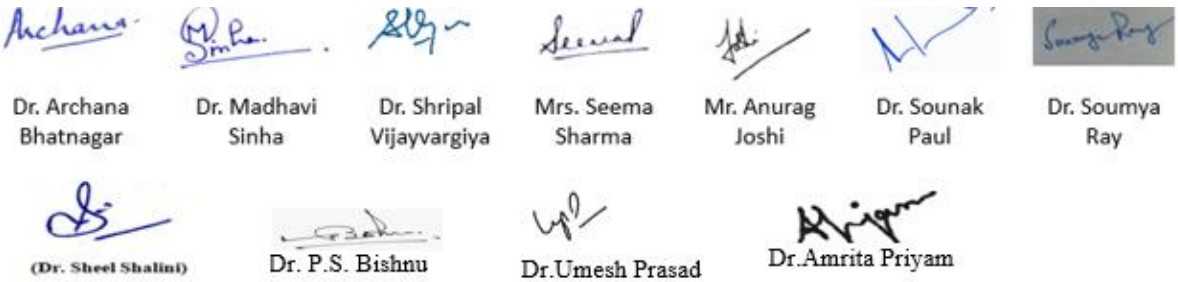
**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty



2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD4,CD5 |
| CD2 | Tutorials/Assignments | CO2 | CD4,CD5 |
| CD3 | Seminars | CO3 | CD4,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD4,CD5 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD4,CD5,CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25407**<br>**:RESEARCH METHODOLOGY** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class:BCA**
**Semester/Level** **:VII /4**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

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(Dr. Sheel Shalini), Dr. P.S. Bishnu, Dr.Umesh Prasad, Dr.Amrita Priyam

| | |
|---|---|
| A. | Studyandunderstandtheresearchissues&challenges, research goals,scientific methods |
| B. | Understand the concepts of Research Design in real-world studies. |
| C. | Gain skills in conducting data gathering activities for research studies through Various tools |
| D. | Get a clear concept of sampling methods in tune with the primary data requirements of any given study. |
| E. | Reviewing Literature and Research Papers; Writing Research Papers, Thesis, Reportsand Project Proposals Plagiarism and Copyrights. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Identify the need for and importance of Research in the context of different situations and environments. |
| CO2 | The basic concepts of research and its methodologies, identify appropriate research topics, select, and define appropriate research problems and parameters. |
| CO3 | Prepare questionnaires,interview schedules, and implement them for primary data collection context of any given study. |
| CO4 | Decide and implement the most appropriate probability/non-probability sampling techniques for a given study. |
| CO5 | Organize and conduct research in a more appropriate manner, writing a research report and thesis. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **ModuleI**<br>**Research An Introductory Approach: Meaning**, Characteristics and Importance, Types of Research, The Research process (Overview and Steps), The Research problem: Definition, need, importance, steps and related dimensions. | **8** |
| **ModuleII**<br>**Research Design:** Meaning, Characteristics of a Good research Design, Types ofResearch Designs, Components of a research Design. | **8** |
| **ModuleIII**<br>**Sources of Collection of Data:** Primary Data (Method questionnaire development), Secondary Data (Sources and Precautions inthe Use of Secondary Data)<br>**Sampling, Methods of Collecting Data: Meaning**, Steps and Types (simple random, stratified random, systematic and cluster samplings), Survey and Observation Methods. | **8** |
| **ModuleIV**<br>**Computer Science Research Context**: Nature of Computer Science(CS)Research, Scientific Methods in Computer Science, Types of Research in CS, Research Methods in Computer Science, Research Paradigms in CS, Challenges for CS Research. | **8** |

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| | |
|---|---|
| **ModuleV**<br>**Research Skills**: Reviewing Literature and Research Papers; Writing Research Papers, Thesis, Reports, and Project Proposals; Formatting, Appendices, Citation Formats and Style; General Conventions, Issues, Plagiarism, and Copyrights. | **8** |

**TEXT BOOKS:**

1. Ghosh,B.N.ScientificMethodandSocialResearch(Sterling:New Delhi)
2. Kothari,C.R.Research MethodologyMethodsandTechniques(NewAge:NewDelhi)
3. Gupta,SantoshResearchMethodologyandStatisticalTechniques(DeepandDeep Publications: New Delhi)

**REFERENCE BOOKS**

1. Research Methodology: A Step-by-Step Guide for Beginners, Kumar, Pearson Education.
2. Practical Research Methods, Dawson, C., UBSPDPvtLtd.
3. Montgomery, Douglas C.&Runger, George C.(2007)3/e, Applied Statistics and Probability for Engineers (Wiley India).
4. KothariC.K.(2004)2/e,ResearchMethodology—MethodsandTechniques(NewAge International, New Delhi).
5. ManagementResearchMethodology: Integration of Principles, Methods, and Techniques (Pearson Education, New Delhi).
6. Krishnaswami,O.R.MethodologyofResearchinSocialScience(HimalayaPublishing House: Mumbai.)

**GapsintheSyllabus(to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (Pos) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

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

**CorrelationLevels1,2or3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery (CD) methods**

| **CD Code** | **CourseDeliveryMethods** | **Course Outcome** | **CourseDelivery Method Used** |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25405**<br>**:SOFT COMPUTING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:SoftComputing Lab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII /4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understandthe conceptoffuzzylogic andcontrollers. |
| B. | Understandthevariousarchitecturesof ANN and itslearningmethods. |
| C. | Learnaboutbasicconceptsofgeneticalgorithmandits operators. |
| D. | UnderstandtheArtificialNeural Networks. |
| E. | UnderstandtheGenetic Algorithms. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

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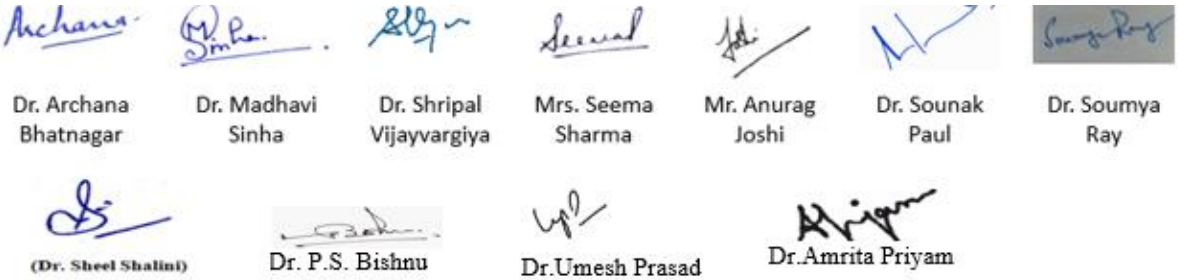
| | |
|---|---|
| CO1. | SolvenumericalonFuzzysetsandFuzzyReasoning. |
| CO2. | DevelopFuzzy InferenceSystem (FIS). |
| CO3. | SolveproblemsonGeneticAlgorithms. |
| CO4. | Explainconceptsofneuralnetworks. |
| CO5. | Developneuralnetworksmodelsforvarious applications. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module– I**<br>**Fuzzy Set Theory:** Basic Definition and Terminology, Set Theoretic Operations, Fuzzy types and levels, MF Formulation and Parameterization, Fuzzy Union, Intersection and Complement, Fuzzy Number, Fuzzy measure. | **8** |
| **Module– II**<br>**Fuzzy Logic:** Fuzzy Rules and Fuzzy Reasoning: Extension Principles and Fuzzy Relations, Fuzzy IF THEN Rules, Defuzzification, Fuzzy Reasoning. Fuzzy Inference System: Introduction, Mamdani Fuzzy Models, Other Variants, Takagi-Sugeno Fuzzy Models. | **8** |
| **Module– III**<br>**Fundamentals of Genetic Algorithms:** Basic Concepts, Creation of Offsprings, Encoding, Fitness Functions, Reproduction, Genetic Modelling: Inheritance Operators, Cross over, Inversion and detection, Mutation operator, Bitwise operators. | **8** |
| **Module– IV** | **8** |
| **IntroductiontoArtificialNeuralNetworks:**WhatisaNeuralNetwork?HumanBrain, Models of Neuron, Neural Network viewed as Directed Graphs, Feedback, Network Architecture, Learning processes (Hebbian, Competitive, Boltzman, Supervised, Unsupervised), Perceptrons, Adaline, Madaline. | |
| **Module– V**<br>Back Propagation Algorithm, Effect Of Tuning Parameters Of The Back Propagation Neural Network, Selection Of Various Parameters In BPN, Associative Memory and Adaptive Resonance Theory, Autocorrelators, Hetro correlators. | **8** |

**TEXTBOOKS**


1. Jang J.S.R., Sun C.T. and Mizutani E., "Neuro-Fuzzy and Soft Computing" PHI/ Pearson Education, New Delhi, 2004.
2. Rajasekaran S. &Vijayalakshmi, G.A. Pai, "Neural Networks, Fuzzy Logic, and GeneticAlgorithms: Synthesis and Applications", PHI, New Delhi, 2003.
3. RossT.J., "Fuzzy Logic with Engineering Applications",TMH,NewYork,1997.
4. Haykins Simon, "Neural Networks: A Comprehensive Foundation", Pearson Education, 2002.

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**REFERENCE BOOKS**


1. Ray K.S.,"Soft Computing and Its application", Vol1, Apple Academic Press.2015.
2. Lee K.H.,"First Course on Fuzzy Theory and App.",Advin Soft Computing Spinger.2005.
3. Zimmermann H.Z.,"Fuzzy Set Theory and its App",4th Edition, Spinger Science,2001.


**Gaps in the Syllabus (to meet Industry/ Profession requirements)**

1. Application of soft computing to develop and design the adaptive controllers.
2. Application of fuzzy inference system for prediction and modelling to complex problems.

**POsmetthroughGapsintheSyllabus-**3, 5

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Conceptsandfeaturesof hardcomputingandsoftcomputing.
2. NN-controllerfor anintelligentandautonomousrobot.
3. MeritsandDemeritsofsoftcomputingtools.

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**2,3,5

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty

2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels 1, 2 or 3 as defined below:**

1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**Mapping Between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25409**<br>**:NATURALLANGUAGE PROCESSING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:Bachelor of Computer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | UnderstandtheN-gramlanguagemodel andNeurallanguage model. |
| B. | Understand the algorithms available for the processing of linguistic information andcomputational properties of natural languages. |
| C. | Understand basic knowledge on various morphological, syntactic, and semantic NLP tasks. |
| D. | Understandvariousparsingalgorithmsof language. |
| E. | Learntoextractfeaturesfromtext.Understand embeddingalgorithms. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Describe the conceptsof morphology,syntax,semantics,discourse &pragmaticsof natural language. |
| CO2 | Understandingofthe relationshipbetweenNLPandstatistics&machine learning. |

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| | |
|---|---|
| CO3 | Discover various linguistic and statistical features relevant to the basic NLP tasks such as spelling detection and correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis. |
| CO4 | DevelopsystemsforvariousNLPproblemswithmoderate complexity. |
| CO5 | Evaluate NLP systems, identify shortcomings and suggest solutions for these short coming. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>IntroductiontoNLP–introductionandapplications,NLPphases,DifficultyofNLP including ambiguity; Spelling error and Noisy Channel Model. | **8** |
| **Module2**<br>Language Modelling: Unigram Language Model, Bigram, Trigram, N-gram, basic Neural network for NLP, Neural Language Modelling with N-gram, smoothing techniques. Evaluating language models; Perplexity vs Entropy. | **8** |
| **Module3**<br>Parts-of-speech Tagging: basic concepts; English word classes; Tag-set; Early approaches: Rule based and TBL; POS tagging using HMM. HMM tagging as decoding.<br>TokenizationandSentence splitting. | **8** |
| **Module4**<br>ParsingBasicconcepts:topdownandbottom-upparsing,treebank; Syntactic parsing: CKY parsing and its application.<br>ContextFreeGrammar.<br>StatisticalParsingbasics:ProbabilisticContextFreeGrammar(PCFG); Probabilistic CKY Parsing of PCFGs. | **8** |
| **Module5**<br>SemanticsVectorSemantics;WordsandVector;MeasuringSimilarity; Semantics with dense vectors: SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW. | **8** |

**TEXTBOOKS:**


1. JurafskyDanandMartinJamesH.“SpeechandLanguageProcessing”,Pearson Education.
2. JurafskyD.andMartinJ.H.,“Speechandlanguageprocessing:AnIntroductionto Natural Language Processing, Computational Linguistics, and Speech Recognition”.


**REFERENCEBOOKS:**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

1. GoldbergYoav"APrimeronNeuralNetworkModelsforNaturalLanguageProcessing.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**
1.VisualizePOSandNERwithSpacy

**POsmetthroughGapsin theSyllabus**-PO1,PO2 &PO3

**Topicsbeyondsyllabus/Advancedtopics/Design**
1.Deeplearningmodelsin NLP

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-PO2&PO3

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty

2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **CO1** | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CO5** | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD8 |

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

| | | | |
|---|---|---|---|
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD3, CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25413** |
| **CourseTitle** | | **:ADVANCEDDATAANALYTICS** |
| **Pre-requisite(s)** | | **:DataAnalytics** |
| **Co-requisite(s)** | | **:AdvancedDataAnalyticsLab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Knowthedataandits characteristics. |
| B. | Understanddatarelationship,advanceddataanalysis:classificationclustering. |
| C. | Understandassociationrulesextractionfromthetransactiondatasetsusingvarious methods. |
| D. | IdentifyTimeseriesdataanalysisfor forecasting. |
| E. | Learntextdata analysis. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Gettheinsightaboutthedata. |
| CO2 | EstablishtheDatarelationshipandableto analyze thedatainmoreadvanceway. |
| CO3 | Extractassociativepatternsfromthetransactionaldata. |
| CO4 | Forecastingaboutthefutureusingthetimeseriesdata analysis. |
| CO5 | Performtextdataanalysis. |

**Syllabus**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **ModuleI**<br>**Dataanalyticsoverview:**Typeofdataanalytics,Descriptive,Diagnostic,Predictive andPrescriptiveAnalytics.VariousgraphicalmethodsofDatavisualization.Various Probabilistic data distributions. Data normalization Multidimensional Data ExamplesandproblemsofhighDimensionaldata.Dimensionreductiontechniques: Principal component analysis. | **8** |
| **ModuleII**<br>**Datarelationship:**Correlationofdata,Simpleandmultipleregressionanalysis,Chi square testing, One way and two ways ANOVA analysis.<br>**PatternClassificationusing:**Bayesianclassifiers,logisticregression.Data<br>**Clustering:**UsingKMeansandKMedoidsmethod,UsingHierarchical methods | **8** |
| **ModuleIII** | |
| **Basicconcept of Association rules extractions:** Market Basket Analysis example. FrequentItemsets,ClosedItemsets,andAssociationRules.FrequentItemsetMining Methods: Apriori Algorithm: Finding Frequent Itemsets by Confined Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, Pattern-Growth Approach for Mining Frequent Itemsets, Mining Frequent Itemsets Using Vertical Data Format, Mining Closed and Max Patterns. | **8** |
| **ModuleIV**<br>**Time Series Data Analysis:** Introduction, Method of Forecasting, Components of time series: Secular Trend, Seasonal Variations, Cyclical Variations, Irregular variations. Methods: Straight line trend, Non-linear trend, Measuring trends by logarithm:Exponentialtrend.MeasurementofSeasonalvariations,Measurementof cyclical and Irregular variations.Auto regression method of forecasting. | **8** |
| **ModuleV**<br>**Text data analysis:** Processing and understanding text-Text tokenization and normalization,Textclassification:MultinomialnaïvebayesandSVMmethod,Text Similarity and clustering: Analyzing term and document similarities, document clustering. Semantic and Sentiment Analysis. | **8** |

**TEXTBOOKS:**


1. HanJandKamberM,"DataMining:Conceptsandtechniques",MorganKaufmannPublishers. 2nd and 3rd Edition.
2. GuptaandGupta,"BusinessStatistics",SultanChandandSons, 2014.


**REFERENCEBOOKS:**


1. SayanMukhopadhyay, "AdvancedDataAnalyticsUsingPython",Apress,2018


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2. MaheshwariAnil,"DataAnalytics",McGrawhillpublication,2017.
3. DipanjanSarkar,"TextAnalyticswithPython",Apress,2016

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**
Workingonreallifedatacollectedfromtheindustriesandinstitutions.

**POsmetthroughGapsintheSyllabus -6**, 9,11and 12

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Someotherclassification andclustering techniques
2. Webdatascrapinganditsanalysis

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**5,8,11,and12

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |

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| | | | |
|---|---|---|---|
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD4 CD8 CD5, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD4 CD8 CD5, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25421**<br>**:REINFORCEMENTLEARNING** |
| **Pre-requisite(s)** | | **:IntroductiontoMachineLearning,DeepLearning** |
| **Co-requisite(s)** | | **:ReinforcementLearningLab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Definethekeyfeaturesofreinforcementlearningthatdistinguishesitfrom AIandnon- interactive machine learning. |
| B. | Given an application problem (e.g. from computer vision, robotics, etc), decide if it shouldbeformulatedas aRLproblem;ifyesbeabletodefineitformally(intermsof thestatespace,actionspace,dynamicsandrewardmodel),statewhatalgorithm(from class) is best suited for addressing it and justify your answer |
| C. | Describe (list and define) multiple criteria for analyzing RL algorithms and evaluate algorithmsonthesemetrics:e.g.regret,samplecomplexity,computationalcomplexity, empirical performance, convergence, etc |
| D. | Describe the exploration vs exploitation challenge and compare and contrast at least two approaches for addressing this challenge (in terms of performance, scalability, complexity of implementation, and theoretical guarantees) |
| E. | Beabletoapply these concepts tosolverealworld problems. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | LearnhowtodefineRLtasksandthecoreprincipalsbehindtheRL,including Markov decision processes, policies, value functions, deriving Bellman equations |
| CO2 | Understandand workwithtabularmethodstosolveclassical controlproblems. |

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| | |
|---|---|
| CO3 | Understandand workwithapproximatesolutions(e.g.Q-networks). |
| CO4 | Learnthepolicygradient methodsfromvanillatomorecomplexcases. |
| CO5 | RecognizecurrentadvancedtechniquesandapplicationsinRL. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>Introduction to Reinforcement Learning – Overview of reinforcement learning concepts and terminology, Markov Decision Processes (MDPs) and Bellman equations, Dynamic programming relation to RL, Value and policy iteration algorithms. | **6** |
| **Module2** | **6** |
| TemporalDifferenceLearning–TDpredictionandTD(0)algorithm,SARSAand Q-learning algorithms, Off-policy and on-policy learning. | |
| **Module3**<br>FunctionApproximationinRL–Linearfunctionapproximation,Featureengineering for RL, Deep Q-Networks (DQN). | **6** |
| **Module4**<br>PolicyGradientMethods–Policyparameterizationandpolicygradients,REINFORCE algorithm, Proximal Policy Optimization (PPO). | **6** |
| **Module5**<br>Explorationstrategies:epsilon-greedy,UCB,Thompsonsampling,Multi-armed bandits and contextual bandits, Upper Confidence Bound (UCB) algorithm. | **6** |

**TEXTBOOKS:**

1. RichardS.SuttonandAndrewG.Barto,"Reinforcementlearning:Anintroduction",Second Edition, MIT Press, 2019

**REFERENCEBOOKS:**

1. Li,Yuxi."Deepreinforcementlearning."arXivpreprintarXiv:1810.06339 (2018).
2. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3..

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3. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."PearsonEducation Limited, 2016.
4. Goodfellow,Ian,YoshuaBengio,andAaronCourville."Deeplearning."MITpress, 2016.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1, CO2, CO3, CO4 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2-CO5 | CD1,CD9 |
| CD3 | Seminars | CO5 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO5 | CD1,CD2 |

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| | | | |
|---|---|---|---|
| CD5 | LaboratoryExperiments/TeachingAids | CO1-CO4 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | CO5 | |
| CD7 | IndustrialVisits/In-plantTraining | CO5 | |
| CD8 | Self- learning such as use of NPTEL Materials and Internets | CO1-CO4 | |
| CD9 | Simulation | CO5 | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25423**<br>**:FEATURE ENGINEERING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Extractusefulfeaturesfromdataandconvertthemtofeatures. |
| B. | Learnhowtodealwithinfrequent,rare,andunseencategories. |
| C. | Learn to transform categorical variables into numbers while capturing meaningfulinformation. |
| D. | Learntoconvertnumericalvariablesintodiscrete ones. |
| E. | Learntechniquestopre-processdataandbuildmorepowerfulmachinelearning models. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Createnewfeaturesfromexistingones. |
| CO2 | Imputemissingdataand encodecategorical variables. |
| CO3 | Transformnumericalvariablesandchangetheir distribution. |
| CO4 | Performdiscretization,removeoutliers,andextractfeatures fromdate&time. |
| CO5 | ReducedimensionalityofdatausingPCA. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **Module1**<br>**Introduction:** Introduction to Feature Engineering, Importance of feature engineering, Evaluation of machine learning algorithm and Feature engineering procedures.<br>**Feature Understanding:** Feature Improvement-cleaning datasets, Feature Selection-removing bad attributes, Feature construction, Feature Transformation, Feature learning. | **8** |
| **Module2**<br>**Data Pre-processing and Missing Values:** Handling missing values, identification, imputation techniques (mean, median, regression-based), and impact on models.<br>**Basics of Feature Representation:** Scalars and Vectors, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling). | **8** |
| | |
| **Module3**<br>**EncodingandTransformationTechniques**<br>Handling categorical variables: one-hot encoding, label encoding, and target encoding,Handlingtextdata:bag-of-wordsrepresentation,TF-IDFencoding,and word embeddings.<br>**Numerical transformations:** handling skewed distributions, logarithmic transformations,andscalingtechniques.Binninganddiscretizationofcontinuous variables. | **8** |
| **Module4**<br>**Feature Selection:** Importance of Feature Selection in Machine Learning, Goals of Feature Selection, Classes of Feature Selection Methodologies. Effect of Irrelevant Feature, Univariate feature selection: statistical tests and feature importance, Recursive Feature Elimination, Stepwise Selection. | **8** |
| **Module5**<br>**FeatureTransformations:**Intuition,Derivation,LinearProjection,Varianceand Empirical Variance - Vector Formulation, General Solution of the Principal Components, Transforming Features, Implementing PCA, PCA in Action, Considerations and Limitations of PCA, Use Cases | **8** |

**TEXTBOOKS:**


1. Max Kuhn , Kjell Johnson, "Feature Engineering and Selection:A PracticalApproach for PredictiveModels"1stEdition,Chapman&Hall/CRCDataScienceSeries,ISBN13-978- 1-138-07922-9.
2. Sinan Ozdemir, DivyaSusarla, "FeatureEngineering MadeEasy", Packt Publishing, ISBN 978-1-78728-760-0


**REFERENCEBOOKS:**


1. AliceZheng&AmandaCasari,"FeatureEngineeringforMachineLearning:Principlesand Techniques for data scientist", Oreilly Publications


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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. UseoftechniquesforMultivariatemissingdataimputationandengineeringmixed variables.
2. Assemblingafeatureengineeringpipeline.

**POsmetthroughGapsin theSyllabus** -1,3, 4,12

**Topicsbeyondsyllabus/Advancedtopics/Design**

3. Outlierhandling
4. UseofClusteringalgorithmsforfeature engineering
5. Imagedatafeature engineering

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design-**1,2,3,4,12

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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| | | | |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/Teaching Aids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25414** |
| **CourseTitle** | | **:ADVANCEDATAANALYTICSLAB** |
| **Pre-requisite(s)** | | **:DataAnalyticsLab** |
| **Co-requisite(s)** | | **:AdvancedData Analytics** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Knowthedataandits characteristics. |
| B. | Understanddatarelationship,advanceddataanalysis:classificationclustering. |
| C. | Understandassociationrulesextractionfromthetransactiondatasetsusingvarious methods. |
| D. | IdentifyTimeseriesdataanalysisfor forecasting. |
| E. | Learntextdata analysis. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Gettheinsightaboutthedata. |
| CO2 | EstablishtheDatarelationshipandabletoanalyzethedatainmoreadvanceway. |
| CO3 | Gettingtheanalysisoftransactiondatatoextracttheassociative patterns. |
| CO4 | Forecastingaboutthefutureusingthetimeseriesdata analysis. |
| CO5 | Thedocumentsclassificationandclusteringbased onthesimilarity'smeasures. |

**Syllabus**

**ListofProgramsasAssignments:**

1. Programondatareading andwritingusingcsvfile.

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2. ProgramonDatavisualization:Variouscharts and Graphs.
3. ProgramonDataNormalization:Max-minnormalizationandStandard normalization.
4. ProgramonDimensionalreductionusingprincipalcomponent analysis.
5. ProgramonCorrelationanalysistocomputethePearsoncoefficientof correlation.
6. ProgramonCorrelationanalysistocomputetheSpearman coefficientof correlation.
7. ProgramonsimpleRegressionandmultipleRegressionAnalysis.
8. Programondataclassificationusing Bayesianclassifiers.
9. Programondataclassificationusinglogisticregression.
10. ProgramondataclusteringusingKMeansandKMedoidsmethod.
11. ProgramondataclusteringusingHierarchical method.
12. ProgramonTimeseriesdataanalysistoknowthe characteristicoftimeseriesdata.
13. ProgramonTimeseries dataanalysisforfuture forecasting.
14. ProgramondocumentClassificationand Clustering.
15. Programonsentimentsanalysisof documents.

**TEXTBOOKS:**


1. SayanMukhopadhyay, "AdvancedDataAnalyticsUsingPython",Apress,2018
2. DipanjanSarkar,"Text AnalyticswithPython",Apress,2016


**REFERENCEBOOKS:**


1. HanJandKamberM,"DataMining:Conceptsandtechniques",MorganKaufmann Publishers. 2nd and 3rd Edition.
2. GuptaandGupta,"BusinessStatistics",SultanChandandSons, 2014.
3. MaheshwariAnil,"DataAnalytics",McGrawhillpublication,2017.


**GapsintheSyllabus(tomeetIndustry/Profession requirements)**
Workingonreallifedatacollectedfromtheindustriesandinstitutions.

**POsmetthroughGapsintheSyllabus** -6, 9,11and 12

**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Someotherclassification andclustering techniques
2. Webdatascrapinganditsanalysis

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-5,8,11,and12

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD4 CD8 CD5, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD4 CD8 CD5, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25422** |
| **CourseTitle** | | **:REINFORCEMENTLEARNINGLAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:ReinforcementLearning** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week** **:04 Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | UnderstandthefoundationsofReinforcement Learning. |

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| | |
|---|---|
| B. | Learnreinforcementlearning algorithms. |
| C. | Gainhands-onexperiencewithRL frameworks. |
| D. | Evaluateand compareRLalgorithms. |
| E. | Experimentwithhyperparametertuning. |

**CourseOutcomes**

Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Explain the fundamental concepts and principles of reinforcement learning, including Markov Decision Processes (MDPs), Bellman equations, and value/policy iteration. |
| CO2 | Develop the ability to implement and apply a variety of RL algorithms, such as temporaldifferencelearning(e.g.,SARSA,Q-learning),policygradientmethods, and function approximation techniques (e.g., Deep Q-Networks). |
| CO3 | ApplyRLtechniquestosolvereal-worldproblemsandpracticalapplications,such as control tasks |
| CO4 | Acquire practical skills by working with popular RL frameworks and libraries, suchasOpenAIGym,TensorFlow,orPyTorch,todesign,train,and evaluateRL agents. |
| CO5 | Gainexperience intuninghyperparametersofRLalgorithmstooptimize their performance, including learning rates, discount factors, exploration rates. |

**Syllabus**

**ListofExperiments**

1. ImplementabasicMDPframeworkandsolveasimplegridworldproblem
2. ImplementTic-tac-ToeusingRL
3. ImplementSARSAalgorithmandevaluatetheirperformanceonaclassicRLbenchmark,such as the FrozenLake environment
4. ImplementQ-learningalgorithmandevaluatetheirperformanceonaclassicRL benchmark
5. Implement a DQN agent using a deep neural network to solve a continuous control task in the OpenAI Gym environment, such as CartPole or LunarLander
6. ImplementtheActor-CriticModel
7. Implement the REINFORCE algorithm for training an RL agent on a continuous action space environment, such as the Pendulum or BipedalWalker
8. Implement the Proximal Policy Optimization (PPO) for training an RL agent on a continuous action space environment, such as the Pendulum or BipedalWalker
9. CompareandcontrasttheReinforcementalgorithmandPPOfortraininganRLagent
10. Implementonepolicygradientmethod.
11. Implement the Upper Confidence Bound (UCB) algorithm and compare its performance with other exploration strategies on a multi-armed bandit problem

**TEXTBOOKS:**

1. RichardS.SuttonandAndrewG.Barto,"Reinforcementlearning:Anintroduction",Second Edition, MIT Press, 2019

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2. ReinforcementLearning:WithOpenAI,TensorFlowandKerasUsingPythonbyAbhishek Nandy, Manisha Biswas, 1st Edition, Apress, 2017

**REFERENCEBOOKS:**

1. Applied Reinforcement Learning with Python: With OpenAI Gym, Tensorflow and Keras. by Taweh Beysolow II, APress, 2019.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (Pos) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery MethodUsed |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1,CO2, CO3, CO4 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2-CO5 | CD1,CD8,CD9 |
| CD3 | Seminars | CO5 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO5 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO1-CO4 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | CO5 | |
| CD7 | IndustrialVisits/In-plantTraining | CO5 | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | CO1-CO4 | |
| CD9 | Simulation | CO5 | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25424** |
| **CourseTitle** | | **:FEATUREENGINEERINGLAB** |
| **Pre-requisite(s)** | | **:PythonProgrammingLab** |
| **Co-requisite(s)** | | **:FeatureEngineering** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understandthedifferenttypesof features. |
| B. | Selectfeaturesthatarerelevantandinformative formachinelearningalgorithms. |
| C. | Evaluatetheeffectivenessoffeature engineering. |
| D. | Applyfeatureengineeringtechniquestoreal-worlddata. |
| E. | Dothefeatureengineeringfornumerical,text,image,audioandtimeseriesdata. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Handlethemissingvaluesusingdifferentimputationtechniquesandindicator techniques. |
| CO2 | Applyencodingtechniquesforcategoricaldataandhandlethetext data. |

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| | |
|---|---|
| CO3 | Applydifferentfeatureselectionmethods. |
| CO4 | Applyoutlierengineeringandfeature transformations. |
| CO5 | Applyfeatureengineeringontimeseriesdataanddomainspecific data. |

**Syllabus**

**ListofProgramsasAssignments:**

1. MissingValues:
- ImputationTechniques: Implement different methods suchas mean,median,mode, or regression-based imputation to fill in missing values.
- Indicator Variables:Create binaryindicator variablestorepresentmissingnessin categorical or numerical features.

2. EncodingCategoricalVariables:
- One-HotEncoding:Convertcategoricalvariablesintobinary vectors.
- LabelEncoding:Assign auniquenumericallabel toeachcategory.

3. NumericalTransformations:
- LogarithmicTransform:Applylogarithmictransformationtohandleskewed distributions.
- Scaling: Normalize numerical features using techniques like standardization (mean 0, standard deviation 1) or min-max scaling (range between 0 and 1).
- Binning:Convertcontinuousvariablesintodiscretebinstocapturenon-linear relationships.

4. DateandTime Features:
- ExtractComponents:Breakdowndatesintoday,month,year,orextracttime-based features like hour of the day, day of the week, etc.

- TimeSince/Until:Calculatethetimedurationbetweentwodatesor events.

5. TextualData:
- Bag-of-Words:Converttextintonumericalvectorsbasedonword frequency.
- TF-IDFEncoding:Assignweightstowordsbasedontheirimportanceinadocument or corpus.

6. InteractionFeatures:
- PolynomialFeatures:Generatehigher-orderpolynomialtermstocapturenon-linear relationships between features.
- InteractionTerms:Createnewfeaturesbymultiplyingorcombiningexistingfeatures.

7. FeatureSelection:
- Univariate Selection: Use statistical tests like chi-square, ANOVA, or correlationcoefficients to select relevant features.
- Recursive Feature Elimination: Iteratively remove less important features based on model performance.
- DimensionalityReduction:ApplytechniqueslikePrincipalComponentAnalysis (PCA) to reduce feature dimensionality.

8. Time-basedFeatures:
- RollingStatistics:Calculatestatisticalmeasures(mean,max,min,etc.)overarolling window of time.
- LaggedVariables:Includepastvaluesofafeatureasadditionalinput,capturing time-dependent patterns.

9. Domain-SpecificFeatureEngineering:
- Createdomain-specificfeaturesbasedonpriorknowledgeoftheproblemdomainon a suitable dataset.

10. FeatureCrosses:
- Combine multiple features to create new composite features. For example, if you havefeaturesAandB,createanewfeaturebymultiplyingAandBorconcatenating their values.

11. GroupingandAggregating:

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- Group data by a categorical feature and calculate aggregate statistics such as mean, sum,count,etc.,onnumericalfeatureswithineachgroup.Theseaggregatedfeatures can capture group-level information.

12. Target-RelatedFeatures:
- Create features based on the relationship between a feature and the target variable. For example, compute the mean or standard deviation of a numeric feature for different values of the target variable.

13. Time-SeriesFeatures:
- Derive features specific to time-series data, such as moving averages, exponential smoothing, autocorrelation, or seasonality indicators.

14. OutlierEngineering:
- Identifyandhandleoutliersbytransformingorcappingextremevalues.Forinstance, replace outliers with the median or mean, or create binary indicator variables to capture the presence of outliers.

15. Domain-SpecificTransformations:
- Apply domain-specific transformations to features. For example, on geographical data, you can calculate distances between points or create clusters based on spatial proximity.

16. TimeSinceLastEvent:
- Calculatethetimedurationsincetheoccurrenceofspecificeventsoractions,which can capture recency information.

17. CompositeFeatures:
- Createcompositefeaturesbycombiningmultipleexistingfeaturesusing mathematical operations (e.g., addition, subtraction, multiplication, division).

**REFERENCEBOOKS:**


1. Max Kuhn , Kjell Johnson, "Feature Engineering and Selection:A PracticalApproach for PredictiveModels"1stEdition,Chapman&Hall/CRCDataScienceSeries,ISBN13-978- 1-138-07922-9.
2. SinanOzdemir,DivyaSusarla,"FeatureEngineeringMadeEasy",PacktPublishing,ISBN 978-1-78728-760-0
3. AliceZheng&AmandaCasari,"FeatureEngineeringforMachineLearning:Principlesand Techniques for data scientist", Oreilly Publications


**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Feature Extraction from Images: Utilize techniques such as convolutional neural networks (CNNs) or pre-trained models (e.g., ResNet ) to extract meaningful features from images.
2. Feature Extraction from Audio: Extract audio features like Mel-frequency cepstral coefficients (MFCC), spectral contrast, or pitch-related features to represent audio data.
3. Feature Importance: Use model-based feature importance techniques like permutation importance or feature importance from tree-based models (e.g., random forests, gradient boosting) to identify the most influential features.

**POsmetthroughGapsin theSyllabus** -1,3, 4,12

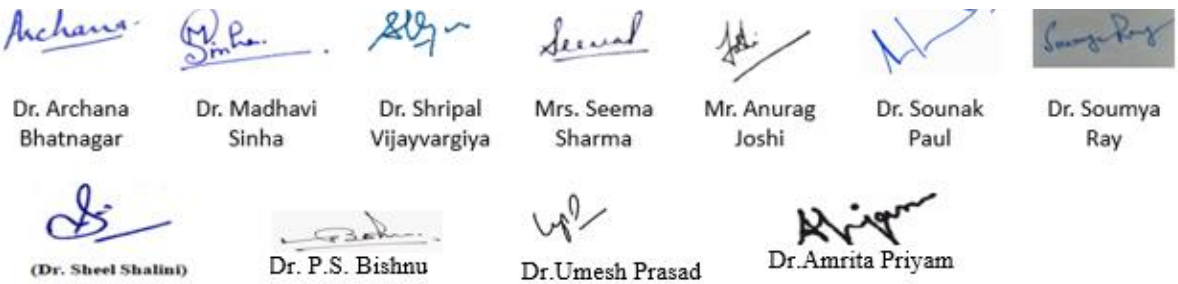
**Topicsbeyondsyllabus/Advancedtopics/Design**

1. Outlierhandling
2. UseofClusteringalgorithmsforfeature engineering
3. Imagedatafeature engineering

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design**-1,2,3,4,12

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**



| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 3 |
| CO2 | 3 | 1 | 3 | 1 | 3 | 3 | 1 | 1 | | | | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 2 | 2 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDelivery Methods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCD Projectors | CO1 | CD1,CD2,CD4 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD4 |
| CD3 | Seminars | CO3 | CD1,CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| CourseCode | | :CN25417 |
|---|---|---|
| CourseTitle | | :COMPUTERVISION |

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| | | |
|---|---|---|
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understandtheconcepts ofcomputer vision. |
| B. | Understandthevariousimageprocessingmethodsusedincomputer vision. |
| C. | Learn aboutbasicconceptsofmodelfittingandoptimization. |
| D. | Learn aboutdeeplearningconcepts. |
| E. | Understand the various feature detection and matching techniques used in computer vision. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Understand the various features of computer vision and basics of transformation techniques. |
| CO2 | Applydifferentimageprocessingtechniquesforsolvingrealworldcomputer vision problems and finding solutions. |
| CO3 | Understandaboutthemodelfittingandoptimizationincomputervisionworld. |
| CO4 | Explaintheconceptsofdeeplearning. |
| CO5 | Implement the feature detection and matching techniques for various applications in computer vision. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>**Introduction:**OverviewofComputerVision,Applications,GeometricPrimitives and Transformations: 2D Transformations, 3D Transformations, 3D to 2D Projections, Photometric Image Formation: Digital Camera. | **7** |
| **Module2**<br>**Image Processing:** Point Operators: Pixel Transforms, Color Transforms, Histogram Equalization, Linear Filtering, 2D Fourier Transforms, Geometric Transformations. | **8** |

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| | |
|---|---|
| **Module3**<br>**ModelFittingandOptimization:**ScatteredDataInterpolation:RadialBasis Functions, Overfitting and Underfitting. | **6** |
| | |
| **Module4**<br>**DeepLearning:**SupervisedLearning:NearestNeighbors,BayesianClassification, Logistic Regression, Unsupervised Learning: Clustering, K-Means, Deep Neural Networks:WeightsandLayers,Backpropagation,ConvolutionalNeuralNetworks. | **10** |
| **Module5**<br>**FeatureDetectionandMatching:**PointsandPatches:FeatureDetectors,Feature Matching, Feature Tracking, Edges and Contours: Edge Detection, Contour Detection. | **5** |

**TEXTBOOKS:**

1. ForsythDavidA.andPonceJean,"ComputerVision.AModernApproach",Pearson Education, 2015.
2. SzeleskiR.,"ComputerVision:AlgorithmsandApplications(TextsinComputerScience)", Springer.

**REFERENCEBOOKS:**

1. Hartley R. and Zisserman A., "Multiple View Geometry in Computer Vision", Cambridge University Press.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

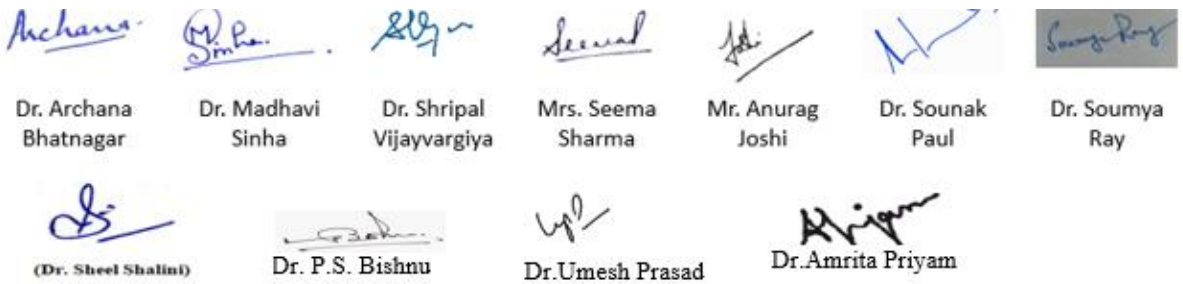
**Direct Assessment**

| **AssessmentTool** | **Contributionduring CO Assessment** |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**



| Course outcome | ProgramOutcomes (Pos) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD3, CD6 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD3,CD6, CD8 |
| CD3 | Seminars | CO3 | CD1,CD3,CD6, CD7 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD3, CD6 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD2,CD6,CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **:CN25419** |
| **CourseTitle** | | **:IMAGEPROCESSING** |
| **Pre-requisite(s)** | | **:MathematicsforComputingI** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Classscheduleperweek** **03**
**Class** **:BCA**
**Semester/Level** **:VIII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understandthe fundamentalsofdigitalimage processing. |

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| | |
|---|---|
| B. | Developabroadknowledgeofdifferenttransformmethodsforenhancingthe image. |
| C. | LearnImagerestorationtechniquesandnoisemodelsusedforrestoringanimage. |
| D. | Understandaboutimagecompressionandimage segmentation. |
| E. | KnowaboutObjectRecognition&learntechniquestoperformthe same. |

**CourseOutcomes**

Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Understandtheconceptofimageformation,digitization,andtherolewhich human visual system plays in perception of image data. |
| CO2 | Acquireanappreciationfortransformtechniquesforenhancingtheappearanceof an image and will be able to apply them in different applications. |
| CO3 | Discernthedifferencebetweennoisemodels,gainaninsightintoassessingthe degradation function and apply noise removal technique. |
| CO4 | Synthesizeasolution toimagecompression. |
| CO5 | Designpattern/objectrecognitionsystem,evaluateitsperformanceandapply improvement techniques. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1** IntroductiontoDigitalImageProcessing:FundamentalStepsinDigitalImage Processing, Components of an Image Processing System; Color Image: Fundamentals, Color Models & various image formats like bmp, jpeg, tiff, png, gif, etc. | **8** |
| **Module2** Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. | **8** |
| **Module3** Image Enhancement & Restoration: Image Enhancement: Basic intensity transformation function, Histogram Processing, Image degradation/RestorationProcess,NoiseModels,Restorationinthepresenceof noise only-Spatial Filtering | **8** |

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| | |
|---|---|
| **Module4**<br>Image Compression & Segmentation: Image Compression: Fundamentals, some basic compression methods; Image segmentation: Fundamentals, point, line & edge detection, thresholding, regionbased segmentation. | **8** |
| **Module5**<br>ImageProcessingApplications:ObjectRecognition:Patterns&Patterns Classes, Recognition using Neural Network, matching shape numbers. | **8** |

**TEXTBOOKS:**

1. Rafael.C.&WoodsRichardE."DigitalImageProcessing",3rdEdition,Pearson Education, New Delhi, 2009.

**REFERENCEBOOKS:**

1. PrattW.K."Digital ImageProcessing",4thEdition,JohnWiley&sonsInc.,2006.
2. SonkaM.,HlavacVaclav,BoyleRoger"ImageProcessing,AnalysisandMachine Vision", 2nd Edition, Thomson Learning, India Edition, 2007.
3. Jayaraman"Digital ImageProcessing",TataMcGraw.HillEducation, 2011.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**CourseOutcome(CO) AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| **AssessmentTool** | **Contributionduring CO Assessment** |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| **Course outcome** | **ProgramOutcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

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**ANNEXURE B DATASCIENCE**

**SEMESTERVII/VIII**

| | | |
|---|---|---|
| **CourseCode** | | : **CN25425** |
| **CourseTitle** | | **:NoSQL DATABASE** |
| **Pre-requisite(s)** | | **:DatabaseManagementSystem** |
| **Co-requisite(s)** | | **:NoSQLDatabaseLab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VII /4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understand the basic concepts and the applications of database systems. To master the basics of SQL and construct queries using SQL. |
| B. | ExploredifferenttypesofNoSQLdatabasesandunderstandtheprinciplesofrelational database design. |
| C. | Understandthearchitectureofdifferenttypesof databases. |
| D. | Becomefamiliarwiththebasicissuesoftransactionprocessingandconcurrency control. |
| E. | Becomefamiliarwithdatabasestoragestructuresandaccesstechniques. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Explainandcomparedifferenttypesof NoSQL Databases. |
| CO2 | CompareandcontrastNoSQLdatabaseswithRDBMS. |
| CO3 | Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL Databases. |
| CO4 | ApplyNoSQLdevelopmenttoolsondifferenttypesofNoSQL database. |
| CO5 | Demonstratethearchitecture,defineobjects,loaddataandperformancetuneColumn oriented, Document-oriented, Graph NoSQL databases. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **ModuleI**<br>**Introduction:** Overview and History of NoSQL Databases. Definition of the Four TypesofNoSQLDatabase,TheValueofRelationalDatabases,GettingatPersistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Point. | **8** |
| **ModuleII**<br>**Evaluating NoSQL:** Introduction, The Technical Evaluation, Choosing NoSQL, SearchFeatures,ScalingNoSQL,KeepingDataSafe,VisualizingNoSQL,Extending Data Layer, Business Evaluation, Deploying Skills, Deciding Open Source versuscommercial software, Business critical features, Security. | **8** |
| **ModuleIII**<br>**Key-Value & Document Based Databases:** Introduction to Key-Value Databases, KeyValueStore,EssentialFeatures,Consistency,Transactions,Partitioning,Scaling, Replicating Data, Versioning Data, How to construct a Key, Using Keys to Locate Values, Hash Functions, Store data in Values, Use Cases, Introduction to Document Databases, Supporting Unstructured Documents, Document Databases Vs. Key- Value Stores, Basic Operation on Document database, Partition, Shading, Features, Consistency, Transactions, Availability, Scaling, Use Cases. | **8** |
| **ModuleIV**<br>**Column-oriented & Graph based Databases:** Introduction to Column Family Database, Features, Architectures, Differences and Similarities to Key Value and Document Database, Consistency, Transactions, Scaling, Use Cases, Introduction to GraphDatabases,Advantages,Features,Consistency,Transactions,Availability, Scaling,Graph&NetworkModelling,PropertiesofGraphsandNoes,Typesof Graphs,UndirectedanddirectedGraph,FlowNetwork,BipartiteGraph,Multigraph, Weighted Graph, Conclusion of Unit. | **8** |
| **ModuleV**<br>**Indexing and Ordering Data Sets:** Essential Concepts Behind A Database Index, Indexing And Ordering In Mongodb, Creating and Using Indexes In Mongodb, Indexing And Ordering In Couchdb, Indexing In Apache Cassandra. | **8** |

**TEXTBOOKS:**

1. Sadalage,P.&Fowler,NoSQLDistilled:ABriefGuidetotheEmergingWorldofPolyglot Persistence, Wiley Publications.
2. NoSQLforDummies,AdamFowler,JohnWiley &Sons.

**REFERENCEBOOKS:**

1. NoSQLforMereMortals,DanSullivan,PearsonEducation.
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", Manning Publication/Dreamtech Press.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

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**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD4, CD5 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |

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| | | | |
|---|---|---|---|
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25431**<br>**:CLOUD COMPUTING** |
| **Pre-requisite(s)** | | **:ComputerNetworks,Operating System** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VII /4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understand software, and other shared resources to be provisioned over the network as services in an on-demand manner. |
| B. | Comprehendthecloudcomputingmodels. |
| C. | Gain knowledge about the different types of cloud computing services namely, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software- as-a-Service (SaaS). |
| D. | Understandvirtualization,securityandprivacyissues. |
| E. | UnderstandCloudOS,federatedclouds. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Describethevariousaspectsofcloudcomputing anddistributedcomputing. |
| CO2 | Understandthespecifics ofvirtualizationandcloudcomputing architecture. |
| CO3 | Develop and deploy cloud application using services of different cloud computing technologies provider: Google app Engine, Amazon Web Services (AWS) and Microsoft Azure. |
| CO4 | ProviderecommendationsoncloudcomputingsolutionsforaGreenenterprise. |
| CO5 | Identifyanddeployappropriatedesignchoiceswhensolvingreal-worldcloud computing problems. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **ModuleI**<br>CloudComputingataglance,DistributedSystems,Virtualization,Web2.0, Service-oriented computing, Utility-oriented computing. | **8** |
| **ModuleII**<br>Eras of Computing, Elements of Distributed Computing, Concepts of Virtualization and its characteristics, Virtualization and cloud computing, cloud reference model, types of clouds, economics of the cloud. | **8** |
| **ModuleIII**<br>CloudPlatformsinIndustry:<br>AmazonWebServices**:**ComputeServices,StorageServices,Communication Services.<br>GoogleAppEngine:ArchitecturalandCoreConcepts,ApplicationLife-Cycle, Cost Model.<br>MicrosoftAzure:AzureCoreConcepts,SQLAzure. | **8** |
| **ModuleIV**<br>Energy-Efficiency in clouds, Energy-Efficient and Green Cloud Computing Architecture, Market-Oriented Cloud Computing, Federated clouds: characterization and definition, cloud federation stack.<br>CloudSecurityandTrustManagement:CloudSecurityDefenseStrategies. | **8** |
| **ModuleV**<br>Application of clouds in: Health care, Biology, CRM, ERP, Social Networking, Productivity and Geoscience. Cloudlets for Mobile Cloud Computing. | **8** |

**TEXTBOOKS:**

1. BuyyaRajkumar, Charles, VecchiolaChristianamdSelviS. Thamarai "Mastering Cloud Computing", McGraw Hill Education (India) Private Limited.

**REFERENCEBOOKS:**

1. Hwang Kai, Fox Geoffrey C., Dongarra Jack J., "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 |
| CO4 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD5,CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD5, CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| CourseCode | | : CN25426 |
|---|---|---|

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| | | |
|---|---|---|
| **CourseTitle** | | **:NoSQL LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:NoSQLDatabase** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Setupandconfigurethelab environment. |
| B. | Makeuseofdifferent commandsinthelab environment. |
| C. | Tocreateandimplementshards. |
| D. | UnderstandthemodelofsystemexistinginvariousITcompanies. |
| E. | UsingandlearningtheMongoDBenvironment. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Designadatabaseforagiven set ofrequirements. |
| CO2 | UseNoSQLanditsvariouscommands. |
| CO3 | Applycommandsongivendatabase. |
| CO4 | Haveknowledgeofcreating,addingshardstothe structure. |
| CO5 | UnderstandtheimportanceofmigrationtoNoSQL. |

**SYLLABUS**

**ListofProgramsasAssignments:**
BelowexperimentscanbeperformedonMongoDBLabbycreatingsinglenode cluster.

1. PrepareandinstallinfrastructureforsettingupMongoDBlab.
2. ExecutesetofbasiccommandsonMongoDBlabenvironment
   a. Login
   b. Displayalldatabases.
   c. Authenticateandlogoutfromdatabases.
   d. Listdowncollections,users,roles
3. ExecutesetofbasiccommandsonMongoDBlabenvironment
   a. Insertdocument.
   b. Updatedocument
   c. Save document.
   d. Displaycollection records
   e. Drop function.
4. XYZ Pvt Ltd. is a famous telecom company. They have customers in all locations. Customers use the company's network to make calls. Government has brought in a regulation that all telecom companies should store call

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details of their customers. This is very important from a security point of view and all telecom companies have to retain this data for 15 years. The company already stores all customer details data, for their analytics team. But due to as urgeinmobileusersinrecentyears,theircurrentdatabasecannothandle huge amounts of data. Currentdatabasestoresonlysixmonthsofdata.XYZPvtLtdnowwantstoscaletheir database and wants to store 15 years of data.
Datacontainsfollowing columns:
Source: Phone number of caller Destination:Phonenumberofcallreceiver Source_location: Caller's city Destination_location: Call receiver's city Call_duration: phone call duration
Roaming:Flagtocheckifcallerisinroaming Call_charge: Money charged for call

5. After discussing the requirements with database and architecture team, it has been decided that they should useMongoDb. You havebeen given thetask to Setup adistributed system (database)suchthatdatafromdifferentlocationsgotodifferentnodes(todistributetheload)

a. Importdatatoshardedcollection.
b. Checkdataoneachshardfordistribution.

6. Executebelowsetsofproblembytakingreferenceofpreviousexperiment andfindout:

a. Addadditional nodeto existing system.
b. Checkthebehaviorofclusteron addingashard.
c. Checkthebehaviorofqueryfor findingadocumentwithsourcelocation Delhi.

7. Casestudyon5differentITCompanieswhoareworkingonMongoDB.Explainonthe below parameters:

a. Whymovedto NoSQL
b. AdvantagesoverNOSQL
BusinessBenefitsTechnology Adaptation

**TEXTBOOKS**

1. "GettingStartedwithNoSQL:YourguidetotheworldandtechnologyofNoSQL",by Gaurav Vaish, Packt Publishing.

**REFERENCEBOOKS**

1. ShashankTiwari,ProfessionalNoSQL,WroxPress, Wiley.

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

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**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25432**<br>**:CLOUDCOMPUTINGLAB** |
| **Pre-requisite(s)** | | **:ComputerNetworks,Operating System** |
| **Co-requisite(s)** | | **:Cloud Computing** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**

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(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understandsoftware,andothershared resources tobeprovisionedoverthenetwork as services in an on-demand manner. |
| B. | Comprehendthecloudcomputingmodels. |
| C. | Gain knowledge about the different types of cloud computing services namely, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software- as-a-Service (SaaS). |
| D. | Understandvirtualization,securityandprivacyissues. |
| E. | Identifyanddeployappropriatedesignchoiceswhensolvingreal-worldcloud computing problems. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | ConfigurevariousvirtualizationtoolssuchasVirtualBox,VMware workstation. |
| CO2 | UseInfrastructureandPlatformservicesprovided byAWS. |
| CO3 | LearnserverlesscomputingusingAWSLambda function. |
| CO4 | UnderstandconceptsofIdentitymanagementusingAWSIAM. |
| CO5 | Createavirtualprivate cloud. |

**Syllabus**

**ListofProgramsasAssignments:**

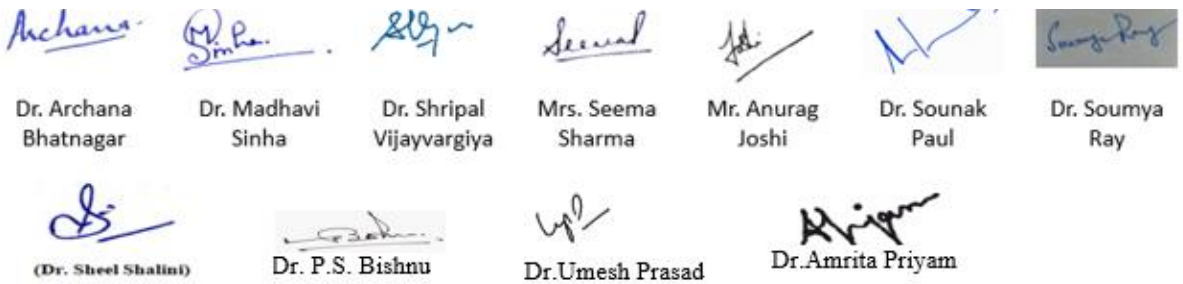
1. InstallVirtualBox/VMwareWorkstationwithdifferentflavorsofLinuxorWindowsOS
2. CreateAmazonAWSEC2Linuxinstancewithconceptualunderstandingof SSH
3. softwareprotocolandkeys.
4. ConfigureWebServeron AmazonLinux Instance.
5. CreatecloudstoragebucketusingAmazonSimpleStorageService (S3).
6. Launchand connecttoAmazonRelationalDatabaseService (RDS).
7. HostyourapplicationinthecloudusingAWSElasticBeanstalk.
8. Createan AWSLambda Functionandaneventto triggerit.
9. Explore**AWSIdentityandAccessManagementUsers,GroupsandPolicies.**
10. CreateVPCusingAmazonVirtualPrivate Cloud.
11. AssignElasticIPAddresstoaEC2instance.

**TEXTBOOKS:**

1. Buyya Rajkumar, Charles, Vecchiola Christianamd Selvi S. Thamarai “Mastering CloudComputing”, McGraw Hill Education (India) Private Limited.

**REFERENCEBOOKS:**

1. HwangKai,FoxGeoffreyC.,DongarraJackJ.,“DistributedandCloudComputingfrom Parallel Processing to the Internet of Things”, Morgan Kaufmann - India Edition.



**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 1 |
| CO2 | 3 | 1 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 |
| CO3 | 3 | 2 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 |
| CO4 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 |
| CO5 | 3 | 2 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD5 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD5 |
| CD3 | Seminars | CO3 | CD1,CD5,CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD5,CD8 |

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| | | | |
|---|---|---|---|
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD5, CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25433**<br>**:DATAPREPROCESSINGANDREPORTING** |
| **Pre-requisite(s)** | | **:IntroductiontoDataScience** |
| **Co-requisite(s)** | | **:DataPreprocessingandReportingLab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **4**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Knowthebasicsofdata Pre-processingandReporting. |
| B. | Knowthebasicsfordata cleaningandIntegration. |
| C. | Translateandpresentdatainstandardformandselectingthefeatures. |
| D. | Haveanunderstandingofhandlingthecategorical andimbalanceddata. |
| E. | Learntowiselyusevariousdatavisualizationtechniquessuchasplots,chartgraphs and reporting of data analysis results. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | DemonstrateunderstandingofDataPre-processingandReportingbasics. |
| CO2 | DemonstrateskillsonDataCleaningand Integration process. |
| CO3 | Applypre-processingtechniquesforvariousdataanalysistasks. |
| CO4 | Demonstrate understanding of handling of categorical and imbalanced techniques. |
| CO5 | Demonstrateskillsinusingdifferenttypesofvisualizationandreportingtoolsand techniques. |

**SYLLABUS**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **ModuleI**<br>IntroductiontoData Preprocessing<br>Overview of the data analysis process, Importance of data pre-processing and reporting, Ethical considerations in data handling and reporting. | **8** |
| **ModuleII**<br>DataCleaningandIntegration<br>Handling missing data: techniques and imputation methods, Dealing with outliers: detection and treatment strategies, Data integration: merging datasets, resolving inconsistencies. | **8** |
| **ModuleIII**<br>DataTransformationandFeatureSelection | **8** |
| Datanormalizationandstandardization,Logtransformationsandpower transformations, Feature selection: identifying relevant variables. | |
| **ModuleIV**<br>HandlingCategoricalDataandData Splitting<br>Encoding categorical variables: one-hot encoding, label encoding, Train-test split:dividingdataformodeldevelopmentandevaluation,Handlingimbalanced datasets: techniques for addressing class imbalance. | **8** |
| **ModuleV**<br>DataVisualization,Reporting,andInterpretation<br>Introduction to data visualization techniques: plots, charts, and graphs, Descriptive statistics: calculating and interpreting summary statistics, Exploratory data analysis (EDA): identifying patterns and relationships, Reporting and communication of data analysis results. | **8** |

**TEXTBOOKS:**


1. Data Science for Business, Authors: Foster Provost and Tom Fawcett, Publisher: O'Reilly Media, Year: 2013
2. PracticalDataCleaning, Author:LeeBaker,Publisher:Kindle Edition
3. DataPreparationforDataMining,Author:DorianPyle,Publisher:MorganKaufmann, Year: 1999 (Revised edition in 2011)
4. PythonDataScienceHandbook,Author:JakeVanderPlas,Publisher:O'Reilly,Year:2016
5. StorytellingwithData,Author:ColeNussbaumerKnaflic,Publisher:Wiley,Year:2015


**REFERENCEBOOKS:**


1. FeatureEngineeringforMachineLearning,Author:AliceZhengandAmandaCasari, Publisher: O'Reilly, Year: 2018
2. DataWrangling with Python, Author: Sarkar Dr. Tirthajyoti, Publisher: Packt Publisher,Year: 2019


**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

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**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery MethodUsed |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD8, |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD4,CD5, CD9 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD8 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |

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| | | | |
|---|---|---|---|
| CD8 | Self-learning such as use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

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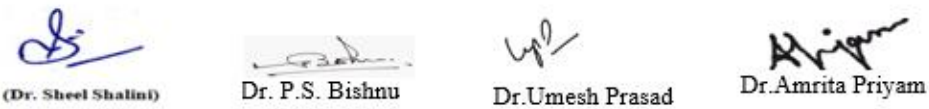

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **:CN25434**<br>**:DATAPREPROCESSINGANDREPORTINGLAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:DataPreprocessingandReporting** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VII/4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Knowaboutthedatapreprocessingandreportingprocess. |
| B. | Differentcategoriesofdatasets,datatypes, andattribute-types. |
| C. | Understandthedifferenttechniquesofdata preprocssing. |
| D. | Reallifeapplicationsofdatapreprocessingfunctionalities. |
| E. | Decidewhatdatareportingtechniquesarerequiredtoobtainthedesiredobjectives. |

**CourseOutcomes**
Afterthe completionofthiscourse,students will be able to:

| | |
|---|---|
| CO1 | Basicsofsuitabletooltoimplementthedatapreprocessingandreportingprocess. |
| CO2 | Methodsandmetricsofdescriptiveandvisualdata analysis. |
| CO3 | Implementthe techniquesof differentdata preprocessingfunctionalitiesusing suitable packages/ libraries/ tools. |
| CO4 | Conductprojectstosolvereallifeproblemsusingthedatapreprocessingmethods and tools. |
| CO5 | Demonstratetheuseofvariousdatavisualization andreportingtools. |

**Syllabus**

**ListofProgramsasAssignments:**
Exercise 1: You have a dataset that contains information about customers, including their age, income, and purchase history. However, the dataset contains missing values in some of the columns. Your task is to handle the missing values appropriately.

a) Loadthedatasetintoa pandas DataFrame.
b) Checkformissingvaluesineachcolumn.
c) Decideonastrategytohandlethemissingvalues.Youcaneitherremovetherowswithmissing values or impute the missing values with appropriate values.
d) Implementyourchosenstrategyandupdatethedatasetaccordingly.

Exercise 2: You have a dataset that contains text data, and you want to pre-process it for natural language processing tasks.

a) Loadthedatasetintoa pandas DataFrame.
b) Removeanyspecialcharacters,numbers,and punctuationmarksfromthe text.
c) Convertthetextto lowercase.

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d) Tokenizethetext intoindividual words.
e) Removestop wordsfrom thetext.
f) Applystemmingorlemmatizationtoreducewordstotheirbaseform.
g) Updatethedatasetwiththepreprocessedtext.

Exercise3:Youhaveadatasetthatcontainscategoricalvariablesencodedasstrings.However,for some categorical variables, there are typos and inconsistent capitalization.

a) Loadthedatasetintoa pandas DataFrame.
b) Examinetheuniquevaluesineach categoricalcolumntoidentifyanyinconsistencies.
c) Cleanthecategoricalvariablesbycorrectingthetyposandensuringconsistentcapitalization.
d) Encodethecategorical variablesusingone-hot encodingorlabelencoding.
e) Updatethedatasetwiththecleanedandencodedcategorical variables.

Exercise4:Youhaveadatasetthatcontainsnumericalfeatures,butsomeofthefeaturesareskewed and have a wide range of values.

a) Loadthedatasetintoa pandas DataFrame.
b) Examinethedistributionofeachnumericalfeatureusinghistogramsordensityplots.
c) Applyatransformationtechnique(suchaslogarithmictransformationorBox-Cox transformation) to reduce skewness and make the distribution more symmetric.
d) Scalethenumericalfeaturestoasimilarrangeusingtechniqueslikemin-maxscalingor standardization.
e) Updatethedatasetwiththetransformedandscalednumericalfeatures.

Exercise5:DataVisualizationandReporting

a. Selectadatasetofinterestforanalysisand reporting.
b. Identifythemainmessageorinsightsyouwantto communicate.
c. Chooseappropriatevisualizationtechniquestosupportyourmessage(e.g.,barcharts,line graphs, scatter plots).
d. Createvisuallyappealingandinformativechartsusingdatavisualizationtools(e.g.,matplotlib, Tableau, Power BI).
e. Organize your findings into a cohesive report, incorporating visualizations, text explanations, and key takeaways.

**Importthenecessarylibraries(suchaspandas,numpy,andsklearn)toperformthese exercises.

**TEXTBOOKS:**


1. Hands-OnDataPreprocessinginPython,byRoyJafari,Publisher(s):PacktPublishing, 2022
2. DataPreprocessinginDataMining"bySalvadorGarcíaandJuliánLuengo,Springer International Publishing Switzerland 2015.
3. Data Wrangling with Python" by Jacqueline Kazil and Katharine Jarmul,O'Reilly MediaInc., 2016


**REFERENCEBOOKS:**

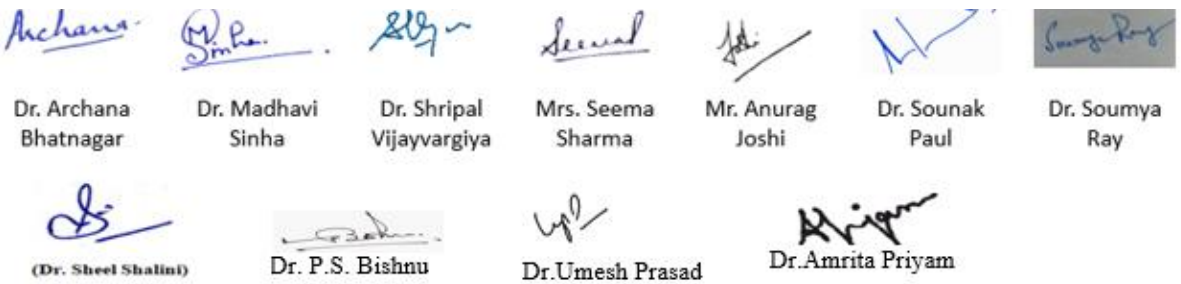

1. "StorytellingwithData:ADataVisualizationGuideForBusinessProfessionals",byCole Nussbaumer Knaflic, Wiley,2015


**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**



**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 1 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 1 | 3 | 3 | 1 | 1 | | | | 2 | 3 | 2 | 2 |
| CO3 | 1 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD2,CD4, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD4,CD5 |
| CD3 | Seminars | CO3 | CD1,CD5,CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD5 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD4,CD5 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25427**<br>**:DATAETHICSAND PRIVACY** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Classscheduleperweek** **04**
**Class** **:BCA**
**Semester/Level** **:VII /4**
**Branch** **:BachelorofComputer Applications**

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Exploretheethicaldimensionsandprivacyimplicationsofdata-driventechnologies. |
| B. | Focusontheresponsiblecollection,analysis,storage,anduseof data. |
| C. | Explorestrategiesforpromotingresponsibledata practices. |
| D. | Understandsocietalimplicationsofdata ethics. |
| E. | Understandtheethicalframeworksandprivacy concerns. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Understandthe fundamentalconceptsandprinciplesofdataethicsandprivacy. |
| CO2 | Identifyethicalissuesandchallengesassociatedwithdata-driven technologies. |
| CO3 | Applyethicalframeworksandguidelinestoaddressdataethicsandprivacyconcerns. |
| CO4 | Developstrategiesforpromotingresponsibledatapracticesandprotecting privacy. |
| CO5 | Analyzetheimpactofbiasesandfairnessindata-drivendecision-making. |

**Syllabus**

| **MODULES** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **ModuleI**<br>IntroductiontoDataEthics,Overviewofdataethicsanditsimportance,Keyethical principles and frameworks, Privacy rights and legal considerations, Ethical Issues in Data Collection, Informed consent and data transparency, Data anonymization and de-identification, Ethical considerations in data sharing and aggregation. | **8** |

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| | |
|---|---|
| **ModuleII**<br>Ethical Data Analysis and Use Responsible data analysis practices, Ethical considerations in AI and machine learning<br>Data-drivendecision-makingandaccountability,BiasandFairnessinData,Types ofbiasindataandalgorithms,Implicationsofbiaseddataandalgorithmicdecision- making. | **8** |
| **ModuleIII** | **6** |

| | |
|---|---|
| EthicalGuidelinesandFrameworks,Internationalandindustry-specificdataethics guidelines, Ethical considerations for data scientists and practitioners, Corporate social responsibility and ethical data governance. | |
| **ModuleIV**<br>Privacy and Data Protection, Data breaches and security risks, Privacy-enhancing technologies and techniques, Privacy regulations and compliance (e.g., GDPR, CCPA). | **6** |
| **ModuleV**<br>SocialImpactofDataEthicsandPrivacy,Surveillancesocietyandimplicationsfor civil liberties, Ethical considerations in data-driven research and public policy, Ethical implications of data-driven business models. | **6** |

**TEXTBOOKS:**

1. "EthicsofBigData"byKordDavisandDougPatterson
2. "PrivacyinContext:Technology,Policy,andtheIntegrityofSocialLife"byHelenNissenbaum
3. "DataEthics:TheNewCompetitiveAdvantage"byDJPatil

**REFERENCEBOOKS**:

1. "ResponsibleDataScience"byFosterProvostandPanos Ipeirotis
2. "Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor" byVirginia Eubanks

**GapsintheSyllabus(tomeetIndustry/Professionrequirements) POs met through Gaps in the Syllabus**

**Topicsbeyondsyllabus/Advancedtopics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | %ContributionduringCOAssessment |
|---|---|
| First Quiz | 10 |

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| | |
|---|---|
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. StudentFeedbackonCourse Outcome

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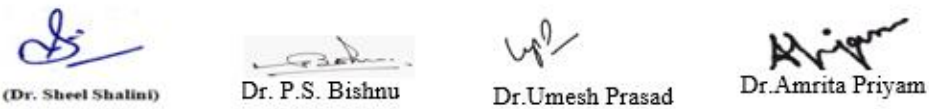

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**Mapping between COs and Program Outcomes**

| Course outcome | ProgramOutcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 4 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelivery Method Used |
|---|---|---|---|
| CD1 | LecturebyuseofBoards/LCDProjectors | CO1 | CD1,CD5,CD7, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD5, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, CD5, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD5, CD8 |
| CD5 | LaboratoryExperiments/TeachingAids | CO5 | CD1,CD2,CD6, CD7, CD9 |
| CD6 | Industrial/GuestLectures | | |
| CD7 | IndustrialVisits/In-plantTraining | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | : **CN25429** |
| **CourseTitle** | | **:CRYPTOGRAPHY&NETWORK SECURITY** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:4** | **L:3T:1** | **P:0** |

**Classscheduleperweek** **4**
**Class** **:BCA**
**Semester/Level** **:VII//4**
**Branch** **:BachelorofComputer Applications**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**CourseObjectives**
Thiscourseenables thestudents to:

| | |
|---|---|
| A. | Understandthefunctionsofcryptographic attacks. |
| B. | Gainknowledgeofsymmetriccryptographic techniques. |
| C. | Enhanceknowledgeof asymmetriccryptographic techniques. |
| D. | Differentiatebetweenthecryptographictechniquesandknowtheirsuitabilitytoan application. |
| E. | Preparestudentsforresearchintheareaofcryptography&networksecurityand enhance problem solving skills. |

**CourseOutcomes**
Afterthe completionofthiscourse,studentswillbeableto:

| | |
|---|---|
| CO1 | Understand the various types of cryptographic attacks and the mathematics behind cryptography. |
| CO2 | Applythesymmetriccryptographictechniquesto solvereallife problems. |
| CO3 | Applytheasymmetriccryptographictechniquestosolvereallife problems. |
| CO4 | DescribedigitalcertificatesandPKIXmodel. |
| CO5 | AnalyzeallrelevantaspectsofsecurityinnetworkslikeE-mailsecurity,PEM& S/MIME, PGP, Firewalls. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **ModuleI**<br>**Introduction**: Security goals, Principles of Security, Cryptographic attacks, Mathematics of cryptography.<br>**Cryptography:ConceptsandTechniques:**Introduction,PlainTextandCipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption,SymmetricandAsymmetricKeyCryptography,Steganography,Key range and Key Size, Possible Types of Attacks. | **8** |
| **ModuleII**<br>**Symmetric Key Algorithms and AES:** Introduction, Algorithm Types and Modes,AnOverviewofSymmetricKeyCryptography,DataEncryptionStandard (DES), International Data Encryption Algorithm (IDEA), RC4, RC5, Blowfish, Advanced Encryption Standard (AES). | **8** |
| | |

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| | |
|---|---|
| **ModuleIII**<br>**AsymmetricKeyAlgorithms,DigitalSignaturesandRSA:**Introduction,Brief History of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm. | **8** |
| **ModuleIV**<br>**DigitalCertificatesandPublicKeyInfrastructure(PKI)**:Introduction,Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards (PKCS), XML, PKI and Security. | **8** |
| **Module V NetworkSecurity:**<br>SystemSecurity-Users,TrustsandTrustedsystems.MaliciousSoftware. Intrusion Detection system (IDS). Firewalls.<br>Security at the Network layer: IPSecSecurityattheTransportlayer:SSLandTLS<br>SecurityattheApplicationlayer:PGPandS/MIME | **8** |

**TEXTBOOKS:**

1. AtulKahate,CryptographyandNetworkSecurity,TataMcGrawHillPublication.

**REFERENCEBOOKS:**

1. BehrouzA.ForouzanandD.Mukhopadhyay,Cryptography&NetworkSecurity,TMH.
2. WilliamStalling,CryptographyandNetworkSecurity–Principle&Practice, Pearson.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Real-timeusecasesand applicationsof cryptography.

**POsmetthroughGapsintheSyllabus–**PO2,PO3and PO5

**Topicsbeyondsyllabus/Advancedtopics/Design**

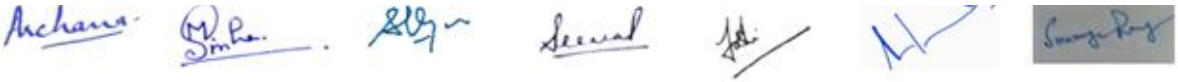
1. Industrybaseduse-case.

**POsmetthroughTopicsbeyondsyllabus/Advancedtopics/Design–**PO5

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| **AssessmentTool** | **%ContributionduringCOAssessment** |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |



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**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 | 1 |
| CO5 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD2,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD5, CD6, CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5, CD6, CD9 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD3,CD7, CD8 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2,CD3, CD6 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **: CN25437** |
| **CourseTitle** | | **: DATA SECURITY** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: DataSecurityLab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week 03**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**Course Objectives**
Thiscourseenvisionstoimparttostudentsto:

| | |
|---|---|
| A. | Able to understand fundamentals of cryptography and its application to network security. |
| B. | Able to understand email security, PEM&S/MIME, PGP, and Firewalls. |
| C. | Understand network security threats, security services, and countermeasures. |
| D. | Acquire background on hash functions, authentication, firewalls, and intrusion detection techniques. |
| E. | Understandvulnerabilityanalysisofnetworksecurityandabletobeintroducedtonew developing security features. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Identifystate-of-the-artandopenproblemsinnetworksecurity. |
| CO2 | Analyze all relevant aspects of security in networks like email security, PEM& S/MIME, PGP, and Firewalls. |
| CO3 | Assess the impact of modes of operation and problems in the network. |
| CO4 | SummariesdevelopingsecurityfeaturesinnetworkingsystemsandRealtime communication security. |
| CO5 | Designofsecuresystemandapplications. |

**SYLLABUS**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module– I**<br>**Introduction,** Security Concepts, Challenges, Security Architecture, Security attacks, security. | **8** |
| **Module– II**<br>**Error detecting/correction:** Block Codes, Generator Matrix, Parity Check Matrix, Minimum distance of a Code, Error detection and correction, Standard Array and syndrome decoding, Hamming Codes. | **8** |
| **Module– III** | **8** |

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| | |
|---|---|
| **Cryptography:** Encryption, Decryption, Substitution and Transposition, Confusion and diffusion, Symmetric and Asymmetric encryption, Stream and Block ciphers, DES, cryptanalysis.<br>Public-key cryptography, Diffie-Hellman key exchange, man-in-the-middle attack, Digital signature, Steganography, Watermarking. | |
| **Module– IV**<br>**Malicious software:** Types of malware (viruses, worms, Trojan horses, rootkits, bots), Memory exploits - Buffer overflow, Integer overflow. | **8** |
| **Module– V**<br>**Security in Internet-of-Things:** Security implications, Mobile device security - threats and strategies, Email mailsecurity, PEM&S/MIME, PGP, Firewalls– Design and Types of Firewalls, Personal Firewalls. | **8** |

**TEXTBOOKS:**

1. Security in Computing, Fourth Edition, by Charles P.Pfleeger, Pearson Education
2. Cryptography and Network Security Principles and Practice, Fourth or Fifth Edition, William Stallings, Pearson.
3. Modern Cryptography: Theory and Practice, by WenboMao, Prentice Hall.

**REFERENCE BOOKS:**

1. NetworkSecurityEssentials: Applications and Standards, by William Stallings. Prentice Hall.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus.**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome(CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**Mapping between COs and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **CO1** | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO2** | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| **CO3** | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| **CO4** | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**CorrelationLevels1,2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping Between COs and Course Delivery (CD) methods**

| CD | CourseDelivery methods | Course Outcome | urse Delivery Method |
|---|---|---|---|
| CD1 | Lecture by use of boards/LCD projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD8,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5 |
| CD4 | Miniprojects/Projects | CO4 | CD1,CD5,CD8, CD9 |
| CD5 | Laboratory experiments/teaching aids | CO5 | CD1,CD2,CD9 |
| CD6 | Industrial/guest lectures | | |
| CD7 | Industrial visits/in-plant training | | |
| CD8 | Self-learning, such as the use of NPTEL materials and internet | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode** | | **: CN25438** |
| **CourseTitle** | | **: DATASECURITYLAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: DataSecurity** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week 04**
**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

Thiscourseenvisionstoimparttostudentsto:

| | |
|---|---|
| A. | Understand the principles of web security and guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools. |
| B. | Exhibitknowledgetosecurecorruptedsystems,protect data and secure computer networks in an organization. |
| C. | Understand network security threats, security services, and counter measures. |
| D. | Acquire background on hash functions, authentication, firewalls, intrusion detection techniques. |
| E. | Havetheabilitytocomparemeritsanddemeritsoftechniquesandtakedecisionswhile securing a network. |

**CourseOutcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Analyseandevaluatethe Cybersecurityneedsof an organization. |
| CO2 | Analyse all relevant aspects of security in networks like email security, PEM& S/MIME, PGP, and Firewalls. |
| CO3 | Measure the performance and troubleshoot cybersecurity systems. |
| CO4 | Summarised developing security features in networking systems. |
| CO5 | Implementation of Secure system applications. |

**Syllabus**

**List of Programs as Assignments:**

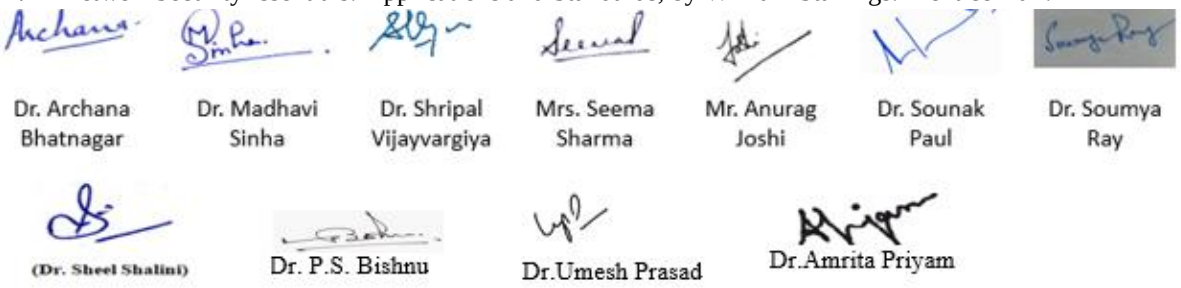
1. Implement the error-correcting code.
2. Implementtheerrordetectingcode.
3. Implementcaeserciphersubstitution operation.
4. Implement monoalphabetic and polyalphabetic cipher substitution operation.
5. Implementplayfairciphersubstitution operation.
6. Implement hill cipher substitution operation.
7. Implement the rail fence cipher transposition operation.
8. Implement row transposition cipher transposition operation.
9. Implement the product cipher transposition operation.
10. Illustrate the ciphertext-only and known-plaintext attacks.
11. Implement a stream cipher technique.

**TEXTBOOKS**


1. Security in Computing, Fourth Edition, by Charles P.Pfleeger, Pearson Education
2. Cryptography and Network Security Principles and Practice, Fourth or Fifth Edition, William Stallings, Pearson.


**REFERENCEBOOK**


1. Modern Cryptography: Theory and Practice, by WenboMao, Prentice Hall.
2. NetworkSecurityEssentials: Applications and Standards, by William Stallings. Prentice Hall.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Viva voce | 20 |
| Day-to-day performance | 30 |
| Exam Evaluation performance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

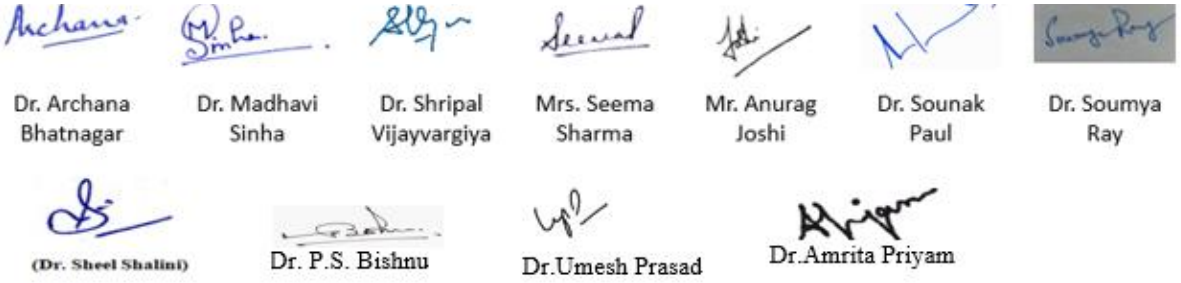
**Mapping between COs and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO4 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

**Mapping between COs and Course Delivery (CD) methods**

| CD | CourseDelivery methods | Course Outcome | Course Delivery Method |
|---|---|---|---|
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | CO1 | CD1,CD8 |
| CD2 | Tutorials /Assignments | CO2 | CD1, CD8, CD9 |



| | | | |
|---|---|---|---|
| CD3 | Seminars | CO3 | CD1, CD2, CD5 |
| CD4 | Mini projects/ Projects | CO4 | CD1, CD5, CD8, CD9 |
| CD5 | Laboratory experiments/teaching aids | CO5 | CD1, CD2, CD9 |
| CD6 | Industrial/guest lectures | | |
| CD7 | Industrial visits/in-plant training | | |
| CD8 | Self-learning, such as the use of NPTEL materials and internet | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25435**<br>**BIG DATA ANALYTICS** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week: 03**
**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the concepts related to Big Data and Artificial Intelligence for data-driven decision making. |
| B. | Understand the explosion of big data in organizations and cultural transformation. |
| C. | Understand Big Data & AI tools & technologies available in market. |
| D. | Explain the merits and limitations of different Big Data architectures. |
| E. | Apply these concepts to solve real-world problems. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Ability to recognize related technologies like AI, IoT, and Digital Reality. |
| CO2 | Ability to define big data & explain the various Vs of Big Data. |
| CO3 | Understand the application of AI for Executives. |
| CO4 | Understand the people component of AI & Big Data. |
| CO5 | Understand the analytical aspects of Big Data. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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| | |
|---|---|
| **ModuleI**<br>**Big Data and its Explosion in Organizations:** Challenges of Data Explosion, CEO's Perspective, Cultural Changes and Strategies for Cultural Transformation, Practising Managers, Practitioner's Perspectives, Formulating the Data Management Strategy<br>**Basics of Big Data:** History of Big Data, Types of Big Data: Structured, Unstructured and Semi-structured Data, Vs of Big Data, Why Big Data Needs Analysis, Creating Values for Businesses using big data, Types of Big Data Analytics, Steps for Big Data Analytics (BDA), Role of Statistics in BDA, Types of Statistical Analysis, Role of Computer Science in BDA. | **6** |
| **ModuleII**<br>**Converging Technologies:** Growth and Evolution of Disruptive Technologies, Internet of Things (IoT), Digital Reality Technologies: AR, VR and MR, Cloud, Big Data Storage Platforms (Apache Hadoop–HDFS), CEPH, Big Data on Cloud, Big Data Analytical Tools, Big Data Visualization Tools, Characteristics of Big Data Tools. | **6** |
| **ModuleIII**<br>**Basics of Big Data Architecture (BDA):** Basic Components of a Big Data Architecture (BDA), Types of Big Data Architecture (BDA): Lambda Architecture, Kappa Architecture, Microservices Architecture, Zeta Architecture, IoT Architecture, Challenges of BDA, Benefits of BDA, Successful BDA Implementations. | **6** |
| **ModuleIV**<br>**Big Data Privacy, Securityand Ethical Concerns:** Privacy Issues, Ensuring Big Data Privacy at Various Stages, Privacy-Preserving Data Publishing (PPDP), Data Anonymization, Data Protection: Roles and Responsibilities, Challenges to Securing Big Data, Ethical Issues and Principles of Big Data Ethics. | **6** |
| **ModuleV**<br>**People Component of BDA:** People as a Prime Component of BDA, Role of a Data Analyst, Business Analyst, DataEngineer/DataArchitect, Big Data Engineer, DataScientist, DataScientist vs DataManager, Machine Learning(ML) Engineer, **Quality Traits:** Personality, Professional Quality Traits<br>**Applications of Big Data Analytics:** Finance Domain, Insurance Sector, HR Domain, Supply Chain Domain, Healthcare Sector, Services Industry. | **6** |

**TEXTBOOKS:**

1. Big Data Analytics Using Artificial Intelligence Technologies: Transforming Organizations, by Rinku Dixit and Shailee Choudhary, Wiley Publishers.

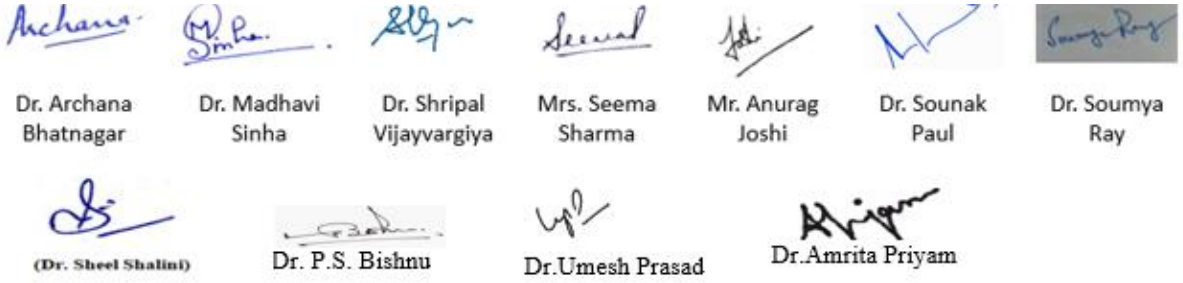
**REFERENCE BOOKS:**

1. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses by Michele Chambers, Ambiga Dhiraj, and Michael Minelli
2. Big Data, Black Book, Dream tech Press

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design.**



## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |

**Correlation Levels 1, 2, or 3 as defined below:**
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**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
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| CD2 | Tutorials/Assignments | CO2-CO5 | CD1,CD9 |
| CD3 | Seminars | CO5 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO5 | CD1,CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO1-CO4 | CD1,CD2 |
| CD6 | Industrial/Guest Lectures | CO5 | |
| CD7 | Industrial Visits/In-plant Training | CO5 | |
| CD8 | Self-learning, such as the use of NPTEL Materials and Internets | CO1-CO4 | |
| CD9 | Simulation | CO5 | |

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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**ANNEXURE C HIGH PERFORMANCE COMPUTING SEMESTER VII/VIII**

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25441**<br>**: MASSIVELY PARALLEL MODELS OF COMPUTATION** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **Massively Parallel Models of Computation Lab** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **:04**
**Class** **: BCA**
**Semester/Level** **: VII/4**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Introduce programming paradigms for parallel computers and the hardware and software used in it. |
| B. | Explain several programming platforms. |
| C. | Learn basic techniques of parallel algorithm development and different parallel communication operations. |
| D. | Address the modeling, analysis, and measurement of program performance. |
| E. | Describe, implement, and use parallel programming. |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understanding of parallel hardware constructs, including instruction-level parallelism. |
| CO2 | Understand the implicit and explicit parallel platform. |
| CO3 | Decompose a given problem into many sub-problems using different decomposition techniques. |
| CO4 | Used different performance metrics for analysis of parallel algorithms. |
| CO5 | Use message passing library for communication among processes running on a parallel platform. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|

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(Dr. Sheel Shalini)
Dr. P.S. Bishnu
Dr.Umesh Prasad
Dr.Amrita Priyam

| | |
|---|---|
| **Module1**<br>**Introduction**: Why parallel computing? Motivating and Scope of Parallel Computing<br>**ParallelHardwareandParallelSoftware:** Von Neumann architecture, Processes, multitasking, and threads, Modifications to the von Neumann Model, Parallel Hardware, Parallel Software, Input and Output, Performance, Parallel Program Design. | **10** |
| **Module2**<br>**Parallel Programming Platforms:** Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques. | **10** |
| **Module3**<br>**Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models**.**<br>**Basic Communication Operations:** One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. | **10** |
| **Module4**<br>**Analytical Modeling of Parallel Programs:** Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs. | **10** |
| **Module5**<br>**Programming Using the Message-Passing Paradigm:** Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations.<br>**MPI:** Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators. | **10** |

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**TEXTBOOKS:**

1. A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to Parallel Computing. 2nd Ed., Pearson, 2011.
2. Peter SPacheco, An Introduction to Parallel Programming, MorganKauFmann, 2011.
3. JosephJa'Ja', An Introduction to Parallel Algorithms, 1st Edition, Addison-Wesley, 1992.

**REFERENCE BOOKS:**

1. V.RajaramanandC.SivaRamMurthy, Parallel Computers Architecture and Programming, PHI Learning Pvt. Ltd., 2012.
2. J. L. Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach, 4th Ed., Morgan Kaufmann/Els India, 2006.
3. M.J.Quinn, Parallel Computing: Theory and Practice, Tata McGraw-Hill,2002.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus.**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid-Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |

**Correlation Levels 1, 2, or 3 as defined below:**

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1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD2,CD5, CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD5, CD8 |
| CD3 | Seminars | CO3 | CD1,CD2,CD5, CD8 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2,CD5, CD8 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2,CD5, CD8 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as the use of NPTEL Materials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25442**<br>**: MASSIVELY PARALLEL MODEL OF COMPUTATION LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week** **: 04**
**Class** **: BCA**
**Semester/Level** **: VII/ 4**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Describe the benefits and applications of parallel computing. |
| B. | Explain architectures of multicore CPU, GPUs, and HPC clusters, including the key concepts in parallel computer architectures, e.g., shared memory system, distributed system, NUMA, and cache coherence, interconnection. |
| C. | Understand principles for parallel and concurrent program design, decomposition of work, task and data parallelism, processor mapping, mutual exclusion, and locks. |
| D. | Write programs that effectively use parallel collections to achieve performance. |
| E. | Use large-scale parallel machines to solve problems as well as discuss the issues related to their construction and use. |

**Course Outcomes**
After the completion, students will be able tontswillbeableto:

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| | |
|---|---|
| CO1 | Understand tasks and data-parallel programs. |
| CO2 | Express common algorithms in a functional style and solve them in parallel. |
| CO3 | Analyze a problem, identify, formulate, and use the appropriate computing and engineering requirements to obtain its solution. |
| CO4 | Write a parallel program using OpenMP, CUDA, and MPI programming models. |
| CO5 | Perform analysis and optimization of parallel program. |

**Syllabus**

**List of Programs as Assignments:**

1. Write a program that uses MPI and has each MPI process print 'Hello world from process iofn' using the rank in MPI_COMM_WORLD for i and the sizeof MPI_ COMM_ MPI_COMM_WORLD for n.
2. Write a parallel program to print any input message supplied by user.
3. Write a parallel program to add two one dimensional arrays of size 'n'.
4. Write a parallel program to add two matrices of order n*n.
5. Write a parallel program to multiply two matrices.
6. Write a parallel program to multiply a matrix of order nxn by a vector of size n.
7. WriteaparallelProgramtocounttheno.ofvowelsinatext.
8. Write a parallel program to find the largest element of n elements.
9. Write a parallel program to count no. characters, words and lines in a file.
10. Write a parallel program to find factorial value of an integer.
11. Write a parallel program to find the transpose of a given matrix.
12. Write a parallel program to implement ring topology.
13. Write a parallel program to find the largest and these cond largest froma a list of elements, considering minimum no. of comparisons.
14. Write a parallel program to sort elements, using any sorting technique.
15. Write a parallel program to solve a set of linear equations using gauss elimination method.
16. Write a parallel program to find the inverse of a given matrix of n*n order.
17. Write a parallel program to find minimal path (minimal cost) in an undirected graph.
18. Write a parallel program to find roots of an equation using N-R method.

**TEXTBOOKS:**


1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Introduction to Parallel Computing (2nd Edition).
2. John Cheng, Max Grossman, and TyMc Kercher,Professional CUDAC PrProgramming, 1st Edition 2014.

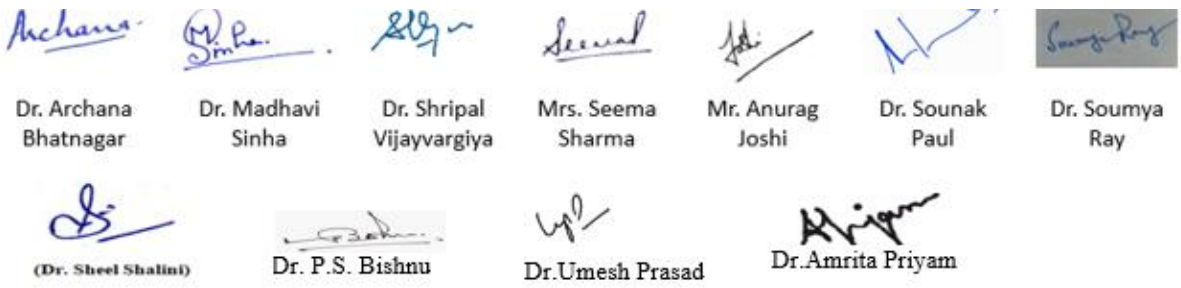

**REFERENCE BOOKS:**


1. Barbara Chapman, GabrieleJost,and RuudvanderPas, Using OpenMP: Portable Shared Memory Parallel Programming, 2007.


**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus.**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design.**



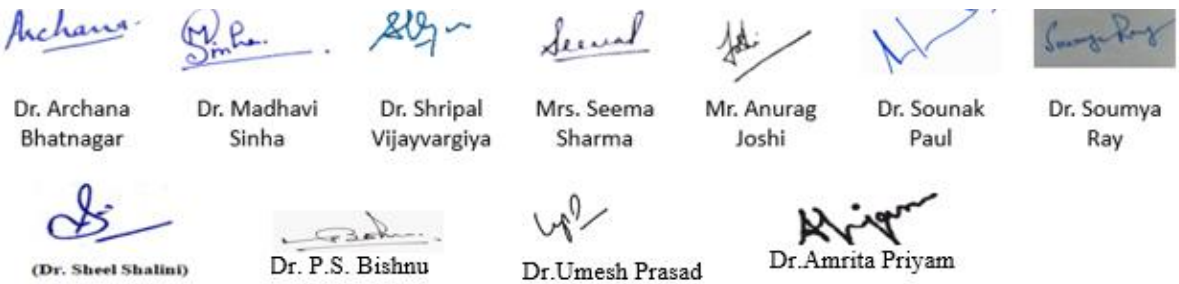
## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (Pos) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 2 |
| CO3 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 2 |
| CO4 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 2 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium)3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD6 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD6,CD7 |
| CD3 | Seminars | CO3 | CDl,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CDl,CD3,CD6, CD7 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2,CD7 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25439**<br>**ADVANCED COMPUTER ARCHITECTURE** |
| **Pre-requisite(s)** | | **Computer Fundamentals &Digital Logic Design** |
| **Co-requisite(s)** | | **:** |
| **Credits:4 L:3** | **T:1** | **P:0** |

**Class schedule per week** **:04 Class** **:BCA**
**Semester/Level** **: VII/4**
**Branch** **: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Provide knowledge of Computer Architecture. |

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| | |
|---|---|
| B. | Employ knowledge of various Digital Logic Circuits, Data Representation, Register and Processor level Design, and Instruction Set architecture. |
| C. | Develop the logical ability to determine which hardware blocks and control lines are used for specific instructions. |
| D. | Understand memory organization, I/O organization, and its impact on computer cost/performance. |
| E. | Knowmerits and pitfalls in computer performance measurements. |

**CourseOutcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | The impact of instruction set architecture on the cost-performance of computer design. |
| CO2 | Explain Digital Logic Circuits, Data Representation, Register and Processor level Design, and Instruction Set architecture. |
| CO3 | Solve problems related to computer arithmetic and determine which hardware blocks and control lines are used for specific instructions. |
| CO4 | Design a pipeline for consistent execution of instructions with minimum hazards. |
| CO5 | Explain memory organization, I/O organization, and their impact on computer cost/performance. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**IntroductionDigitalLogicDesign**: Axioms and Laws of Boolean algebra, Reduction of Boolean expressions, conversion between canonical forms, Karnaugh map (4 variable), Half Adder, Full Adder, Parallel Parity Bit Generator, Checker Circuit, Decoder, Encoder, Multiplexer, RAM, ROM, Memory Organization, Sequential Circuits, State transistors, Flip-flop, RS, JK, D-Latch, Masterslave. | **10** |
| **Module2** | **10** |
| **Instruction Set Architecture Memory Locations and Addresses**: Byte Addressability, Big-Endian and Little-Endian Assignments, Word Alignment, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Subroutines, Additional Instructions, dealing with 32-bit Immediate Values. | |
| **Module3**<br>**BasicProcessingUnit& Pipelining**<br>Basic Processing Unit**:** Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control, CISC Style Processors.<br>**Pipelining:** Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Pipeline Performance Evaluation. | **10** |
| **Module4:**<br>**Memory Organization Basic Concepts**, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories, Performance Considerations, Virtual Memory, Memory Management Requirements, Secondary Storage. | **10** |

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| | |
|---|---|
| **Module5:**<br>**InputOutput:BasicInputOutput**: AccessingI/ODevices, Interrupts, InputOutput Organization: Bus Structure, Bus Operation, Arbitration, Interface, Interconnection Standards.<br>**Parallel Processing:** Hardware Multithreading, Vector (SIMD) Processing, Shared-Memory Multiprocessors, Cache Coherence, Message-Passing Multicomputers, Parallel Programming for Multiprocessors, Performance Modelling. | **10** |

**TEXT BOOKS:**

1. HamacherCarl,et.al, "Computer Organization and Embedded Systems",6thEdition,Tata McGraw Hill, New Delhi.
2. ManoM.Morris, "Computer System Architecture", Revised 3rd Edition, Pearson Education.

**REFERENCE BOOKS:**

1. PattersonDavidA., "Computer Organization and Design: The Hardware/Software Interface", 5th Edition.

**Gaps in the Syllabus (to meet Industry/ Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome(CO)AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 3 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCDProjectors | CO1 | CD1,CD6 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2,CD6 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3, |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD3, |
| CD5 | Laboratory Experiments/TeachingAids | CO5 | CD1,CD2,CD3, CD4, CD5 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | : **CN25443**<br>**: HIGHPERFORMANCECLUSTER COMPUTING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class: BCA**
**Semester/Level: VII/ VIII/ 4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Gain a solid understanding of the principles and concepts underlying high-performance cluster computing, including parallel processing, fault tolerance, and scalability. |
| B. | Explore the architecture and components of high-performance clusters, including hardware, network topologies, and cluster management software. |
| C. | Learn parallel and distributed programming models, such as MPI and frameworks like Hadoop and Spark, to effectively harness the computing power of clusters. |
| D. | Develop practical skills in deploying and managing high-performance clusters, including configuration, installation, resource allocation, and job scheduling. |
| E. | Discover performance optimization techniques specific to cluster computing, such as profiling, load balancing, and parallel algorithm optimization, to maximize the efficiency and speed of cluster-based computations. |

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**CourseOutcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate a comprehensive understanding of the principles and concepts underlying high-performance cluster computing. |
| CO2 | Design and implement parallel and distributed algorithms to leverage the computing power of clusters effectively. |
| CO3 | Configure, deploy, and manage high-performance clusters, including hardware, software, and networking components. |
| CO4 | Utilize parallel programming models and frameworks to develop efficient cluster-based applications. |
| CO5 | Analyzeandoptimizethe performance of cluster-based computations through techniques such as load balancing, task scheduling, and resource allocation. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>What is cluster computing? Approach to parallel computing, how to achieve low-cost parallel computing through clusters, definition, and architecture of a cluster, and what functionality a cluster can offer? Categories of clusters. | **8** |
| **Module2**<br>Clustermiddleware: an introduction, levels and layers of single system image (SSI), cluster middleware design objectives, resource management and scheduling. | **8** |
| **Module3**<br>Cluster programming environment and tools, threads, message passing system, PVM, distributed shared memory, parallel debugger, performance analysis tools, Cluster Administrative tools. | **8** |
| **Module4**<br>Networking, p, and I/O for clusters, networks, and interconnection/ switching devices, design issues in interconnection networking/ switching, HiPPI, ATM, Myrinet, memory channel, and Gigabit Ethernet. | **8** |
| **Module5**<br>Cluster technology for high availability: Highly available clusters, highly available parallel computing, types of failure and errors, cluster architecture and configurations for high availability, faults, and error detection. | **8** |

**TEXTBOOKS:**

1. C.S.R.Prabhu, Grid and Cluster Computing, PHI Learning, New Delhi.

**REFERENCE BOOKS:**

1. Rajkumar Buyya, High-Performance Cluster Computing: Architectures and Systems, Volume 1, Prentice Hall PTR, 2007
2. RichardS.Morrison, Cluster Computing Architectures, Operating Systems, Parallel Processing & Programming Languages.

**GapsintheSyllabus(tomeetIndustry/Profession requirements)**

1. Limited coverage of containerization and orchestration technologies for cluster deployment and management.

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2. Inadequate exposure to distributed storage systems and data processing frameworks for handling large-scale data workloads in industry.

**POsmet through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome(CO)AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

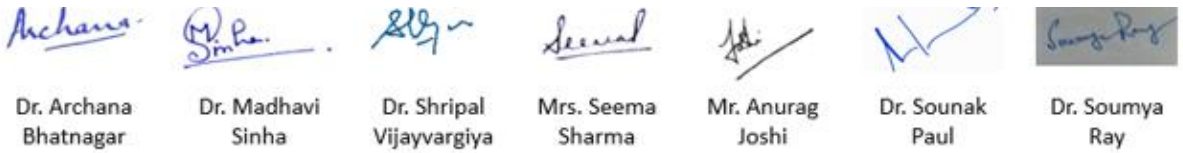
**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 1 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 2 |
| CO3 | 1 | 3 | 3 | 4 | 2 | 3 | 3 | 4 | 2 | 2 | 3 | 4 | 2 | 3 | 2 |
| CO4 | 4 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 4 | 3 | 2 | 2 | 4 | 3 | 2 | 1 | 4 | 3 | 2 |

**Correlation Levels 1, 2, or 3 as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery(CD)methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture using Boards/LCD Projectors | CO1 | CD1,CD2 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD2 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |



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| | | | |
|---|---|---|---|
| CD4 | Mini Projects/Projects | CO4 | CD1,CD4 |
| CD5 | Laboratory Experiments/TeachingAids | CO5 | CD1,CD3 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25445**<br>**: GRID COMPUTING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite( s)** | | **Grid Computing Lab** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week 03**
**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the elements of distributed computing and core aspects of Grid computing. |
| B. | Understand the concepts and aspects of virtualization and the application of virtualization technologies in a Grid computing environment. |
| C. | Understand the architecture and concept of the Grid. |
| D. | Understand the key security, compliance, and confidentiality challenges in Grid computing. |
| E. | Understand the commonly used Grid programming platforms,tools, and simulators. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | RecallthevariousaspectsofGridcomputinganddistributedcomputing |
| CO2 | Understand the specifics of virtualization and Grid computing architectures. |
| CO3 | Develop and deploy a Grid application. |
| CO4 | Evaluate the security and operational aspects in Grid system design, identify and deploy appropriate design choices when solving real-world Grid computing problems. |
| CO5 | Identify and deploy appropriate design choices when solving real-world Grid computing problems. |

**SYLLABUS**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction:** Motivation; Definitions of Grid Computing; Evolution of the Grid; Differences with similar efforts (Meta, cluster, heterogeneous, Internet); Examples of usage; Research possibilities/scope in Grid Computing; Thrust areas.<br>**High Performance computing:** PACX-MPI, MPI-Connect, P-MPI; I-WAY experiment. | **10** |
| **Module2**<br>**EarliestGridTools/Projects:**CondorPart1,Part2;GlobusPart1,Part2;Nimrod. | **8** |
| **Module3**<br>**GridBasics-Technologies/Challenges:** Security-Different models: SSL, Kerberos, SASL, GSI, Others; Information Services: NWS. | **7** |
| **Module4**<br>**HPC and Grids:** Scheduling HPC applications in Grids: AppLeS, Scheduling Parameter sweep applications, Metascheduling Part1, Part2; Grid RPC mechanisms - Part1, Part2; Rescheduling; Computational Steering, Scientific visualization of Grid applications; Grid Applications - Everywhere and Cactus experiments; Data management: Data distribution, Redistribution, Data cache maintenance. | **10** |
| **Module5**<br>**Recent Efforts:** Grideconomy; Gridsimulation-SimGrid, GridSim, MicroGrid; Grid standards and forums - OGSA, GGF. | **5** |

**TEXT BOOKS:**


1. **IanFoster, Carl Kesselman**; The Grid: Blueprint for a New Computing Infrastructure; Morgan Kaufmann Publishers; 2nd edition, 2003.
2. **FrancineBerman, GeoffreyFox, Tony Hey**; Grid Computing: Making the Global Infrastructure a Reality; John Wiley & Sons, 2003.


**REFERENCE BOOKS:**


1. **Jarek Nabrzyski, Jennifer M. Schopf, Jon Weglarz**; Grid Resource Management: State of the Art and Future Trends; Kluwer Academic Publishers, 2003.


**Gaps in the Syllabus (to meet Industry/Profession requirements): POs met through Gaps in the Syllabus.**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |

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| | |
|---|---|
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COS and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 3 |

**CorrelationLevels1,2 or3asdefinedbelow:**

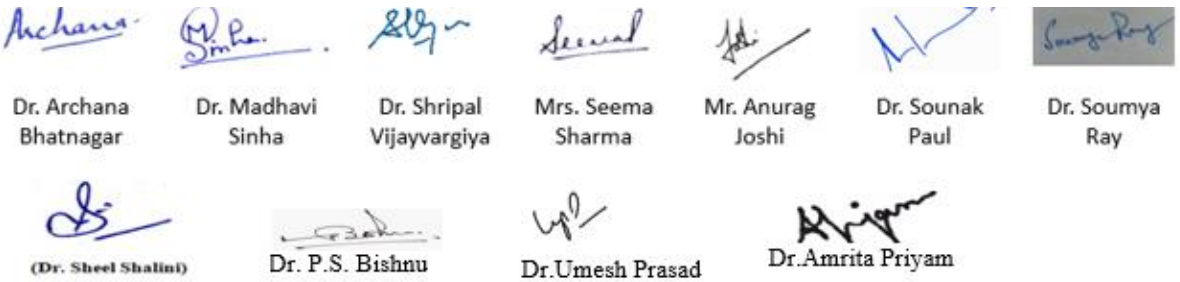
1: Slight (Low) 2:Moderate(Medium) 3:Substantial(High)

**Mapping Between COS and Course Delivery (CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25447**<br>**: INTRODUCTION TO QUANTUM COMPUTING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week 03**
**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**



**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the classical computer. |
| B. | Understand the concepts and aspects of quantum entanglement. |
| C. | Understand the concept of Quantum Teleportation. |
| D. | Understand the concept of quantum cryptography. |
| E. | Understand the commonly used Quantum programming platforms, tools, and simulators. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | UnderstandthesupremacyofQuantumcomputer. |
| CO2 | RecallthevariousaspectsofQuantumcomputingPlatform. |
| CO3 | Understand the specifics of Quantum Computing Parallelism. |
| CO4 | Develop and deploy a QuantumComputing application. |
| CO5 | Evaluate the concept of Quantum cryptography. |

**SYLLABUS**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**QuantumMechanicalPreliminaries:**<br>Origin of Quantum Mechanisms and Its Scope.<br>Two Fundamental Ideas of Quantum Mechanics: Idea of Discreteness, Idea of Wave-Particle Duality. Uncertainty Relations and Results ensuing Therefrom<br>Mathematical Preliminaries: Introduction, Operator Concept: Linear operators, Hermitian operator, and Eigenvalue of problem, Important Theorems on Operators, Basic Postulates of Quantum mechanics.<br>Bra-ket notations: Eigen states and eigenvalues of operators.<br>Principle of Superposition of States and Interference of Transmission Amplitudes Measurement in Quantum Mechanics. Matrix representation of operators and eigenstates. | **8** |
| **Module2** | |
| **QuantumModelofComputation:**<br>Classical Bit, Quantum Bits, Mathematical Foundation of Quantum Bit, Dirac Notation for Quantum Bit, Matrix Representation of Superposition States of Qubit, The Bloch Sphere, Myth About a Single Qubit, Quantum Measurement Postulate, Bipartite System and Multipartite System. | **8** |

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| | |
|---|---|
| **Module–3**<br>**QuantumCircuitModel:**<br>Turing Machine, Quantum Turing Machine, Quantum Circuit, Introduction of QuantumGates: SingleQubitQuantumGates, QuantumNOTGate, QuantumZGate, QuantumY Gate, Quantum Hadamard Gate, Phase Gate. T Gate, Relationship of Single Qubit Quantum Gates and Pauli Matrices, Representation of Single Qubit Quantum Gates on Bloch Sphere, Implementation of Single Quantum Gate Using Python Programming Language, Overview of Qiskit. | **8** |
| **Module4**<br>**Quantum Supremacy**<br>Mathematical Background, Visual Representation of Multipartite State, Multiple Qubit, QuantumGates-ControlledNotGate**:** SWAPGate, ControlledZGate, Toffoli Gate.<br>Matrix Representation of Quantum Circuit, Half Adder, ORACLE, No Cloning Theor**e**m, Quantum Parallelism. | **8** |
| **Module5**<br>**ApplicationofQuantumComputing**<br>SimpleQuantumAlgorithms-Shor's Algorithm, QuantumFourierTransformation, Quantum Search Algorithms.<br>Physical Realization of Quantum Computers, Bell State, Quantum Teleportation. | **8** |

**TEXT BOOKS:**

1. **Michael A.Nielsen, Isaac L. Chuang;** Quantum Computation and Quantum Information; Cambridge University Press**;** 10th edition, 2010.

**REFERENCE BOOKS:**

1. **Nikhil Ranjan Roy;** Introduction to Quantum Mechanics; Vikash Publishing House Pvt Ltd, Ist Edition, 2015.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

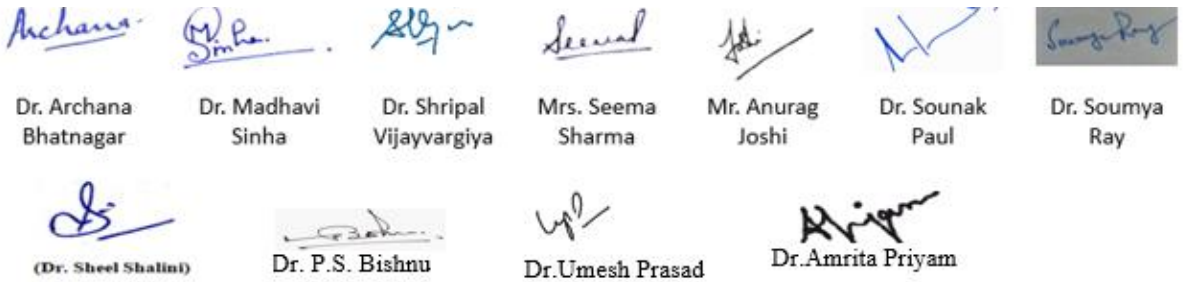
**Course Outcome(CO)AttainmentAssessmentTools&EvaluationProcedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty



2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 3 |

**CorrelationLevels1,2 or3asdefinedbelow:**
1: Slight (Low) 2:Moderate(Medium) 3:Substantial(High)

**Mapping Between COs and Course Delivery(CD)methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as the use of NPTEL Materials and Internet | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25444**<br>**CLUSTER COMPUTING LAB** |
| **Pre-requisite(s):** | | |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week 04**
**Class: BCA**
**Semester/Level: VIII/ 4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Develop practical skills in setting up and configuring a high-performance cluster environment for distributed computing tasks. |

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| | |
|---|---|
| B. | Gain hands-on experience in utilizing cluster computing frameworks like Apache Spark for distributed data processing and analytics. |
| C. | Learn to design and implement parallel algorithms using cluster computing techniques to solve computationally intensive problems efficiently. |
| D. | Understandloadbalancingandtaskschedulingstrategiestooptimizeresource utilization and improve overall cluster performance. |
| E. | Enhance proficiency in performance analysis, profiling, and optimization techniques for cluster-based applications. |

**CourseOutcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate proficiency in setting up and configuring a high-performance cluster environment for efficient distributed computing tasks. |
| CO2 | Apply cluster computing frameworks like Apache Spark to perform distributed data processing and analytics tasks effectively. |
| CO3 | Design and implement parallel algorithms using cluster computing techniques to solve complex computational problems with improved performance. |
| CO4 | Evaluate and optimize the performance of cluster-based applications through performance analysis, profiling, and tuning techniques. |
| CO5 | Develop practical skills in load balancing, task scheduling, and resource management for optimal utilization of cluster resources. |

**Syllabus**

**List of Programs as Assignments:**

1. Installing and Configuring PySpark, Apply any standalone program.
2. Use the Python library Charm4py for cluster computing
3. Use Dask(a library for parallel computing in Python)
   Create a Random array
   Create Random Data
   Create Random Dataframe
   Create simple functions
   Parallelize Normal Python code
4. Studyandusefunctiondispy(DistributedandParallelComputing)
5. ParallelPython and for parallel execution of Python code on SMP (systems with multiple processors) and clusters (computers connected via a network).
6. Useoffunction mpi4py
   Createavenv andinstall scipy
   Installandtest mpi4py
   Parallelizing the map method

**TEXT BOOKS:**


1. Bill Chambers and Matei Zaharia, Spark: The Definitive Guide, Big Data Processing Made Simple, O'Reilly Media, Inc.
2. Francesco Pierfederici, Distributed Computing with Python, PACKT Publishing.
3. C.S.R.Prabhu, Grid and Cluster Computing, PHI Learning, New Delhi.


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**REFERENCE BOOKS:**


1. Rajkumar Buyya, High-Performance Cluster Computing: Architectures and Systems, Volume 1, Prentice Hall PTR, 2007
2. RichardS.Morrison, Cluster Computing Architectures, Operating Systems, Parallel Processing & Programming Languages.
3. https://wiki.python.org/moin/ParallelProcessing


**Gaps in the Syllabus (to meet Industry/Profession requirements)**

1. Cloud Computing Integration
2. BigDataProcessing: Incorporating a component on big data processing frameworks like Apache Hadoop or Apache Flink

**POsmetthroughGapsintheSyllabus:1,3,4,12 Topics beyond syllabus/Advanced topics/Design**

1. Containerization and Orchestration: Introducing containerization technologies like Docker and container orchestration platforms like Kubernetes to enable students to deploy and manage cluster computing applications in a containerized environment.
2. DistributedMachineLearning: Exploring distributed machine learning frameworks such as TensorFlow or PyTorch in the context of cluster computing.

**POs met through Topics beyond syllabus/ Advanced topics/ Design-**1, 2, 4, 7

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 |
| CO4 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| CO5 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 1 | 3 |

**Correlation Levels 1, 2 or 3 as defined below:**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

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1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | CourseDeliveryMethods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD3,CD4,CD5 |
| CD2 | Tutorials/Assignments | CO2 | CD2,CD5 |
| CD3 | Seminars | CO3 | CD3,CD4,CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD3,CD4,CD8 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD3,CD4 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learning, such as the use of NPTEL Materials and Internet | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25446**<br>**GRID COMPUTING LAB** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **: Grid Computing** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week 04**
**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | UnderstandtheelementsofGridcomputingToolkit. |
| B. | Understand the concepts of virtualization in a grid environment. |
| C. | Understand the architecture Grid Computing Toolkit. |
| D. | Understand the key security challenges in the Grid Toolkit. |
| E. | Understand the commonly used GridsimulatOr. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Recallthevariousaspects ofGridcomputing. |
| CO2 | Understand the concepts of virtualization in a grid environment. |
| CO3 | Understand the specifics of Grid computing architectures. |
| CO4 | Develop and deploy the Grid Toolkit. |
| CO5 | Deploy appropriate design choices when solving real-world Grid computing problems. |

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**SYLLABUS**

**List of Programs as Assignments:**
UseGlobusToolkitorequivalentanddothefollowing:

1. Develop a new Web Service for Calculator.
2. Develop a new OGSA-compliant Web Service.
3. Using Apache AxisdevelopaGridService.
4. DevelopapplicationsusingJavaorC++GridAPIs.
5. Develop secure applications using basic security mechanisms available in Globus.
6. Toolkit.
7. DevelopaGrid portal, where users can submit a job and get the result.
8. Findproceduretorunthe virtualmachineofdifferentconfiguration.
9. Checkhowmanyvirtual machinescanbeutilized a particular time.
10. Findproceduretoattach virtualblocktothevirtualmachineandcheckwhetherit
11. holdsthedataevenafter thereleaseofthevirtual machine.
12. InstallaC++compilerinthevirtualmachineand execute a sample program.
13. Show the virtual machine migration based on the certain condition from one node to the other.
14. Findproceduretoinstallstoragecontrollerandinteractwithit.
15. Findprocedureto setuptheonenodeHadoop cluster.
16. Mount the one-node Hadoop cluster using FUSE.
17. Write a program to use the APIs of Hadoop to interact with it.
18. WriteawordcountprogramtodemonstratetheuseofMapand ReducetasksInstall.

**TEXT BOOKS:**

1. **Ian Foster, Carl Kesselman**; The Grid: Blueprint for a New Computing Infrastructure (2nd edition)**;** Morgan Kaufmann Publishers; 2nd edition, 2003.
2. **FrancineBerman, Geoffrey Fox, Tony Hey**; Grid Computing: Making the Global Infrastructure a Reality; John Wiley & Sons, 2003.

**REFERENCE BOOKS:**

1. Jarek Nabrzyski, Jennifer M.Schopf, Jon Weglarz; Grid Resource Management: State of Art and Future Trends; Kluwer Academic Publishers, 2003.

**Gaps in the Syllabus (to meet Industry/ Profession requirements) POs met through Gaps in the Syllabus**

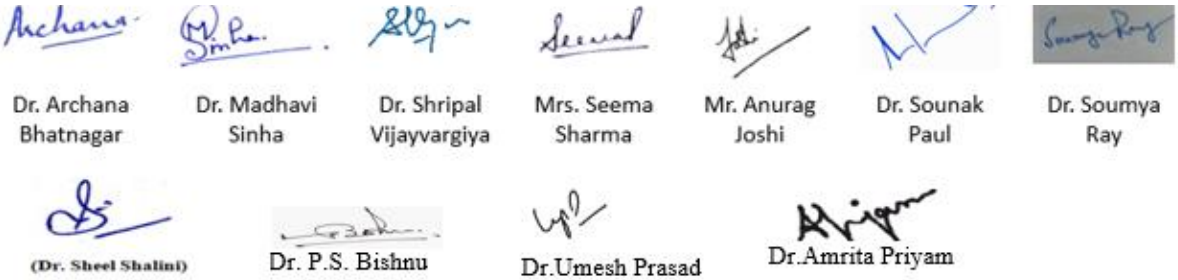
**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design.**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |



| | |
|---|---|
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 3 |

**CorrelationLevels1,2 or3asdefinedbelow:**
1: Slight (Low) 2:Moderate(Medium) 3:Substantial(High)

**Mapping between COs and Course Delivery (CD) methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25448**<br>**QUANTUM COMPUTING LAB** |
| **Pre-rquisite(s)** | | **:** |
| **Co-requisite(s)** | | **Introduction to Quantum Computing** |
| **Credits:2 L:0** | **T:0** | **P:4** |

**Class schedule per week** **04**
**Class: BCA**

Dr. Archana Bhatnagar | Dr. Madhavi Sinha | Dr. Shripal Vijayvargiya | Mrs. Seema Sharma | Mr. Anurag Joshi | Dr. Sounak Paul | Dr. Soumya Ray

(Dr. Sheel Shalini) | Dr. P.S. Bishnu | Dr.Umesh Prasad | Dr.Amrita Priyam

**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the elements of Quantum Computing Toolkit. |
| B. | Understand the concepts of Quantum Supremacy. |
| C. | UnderstandthearchitectureofQuantumComputingToolkit. |
| D. | Understand the application of Quantum Computing. |
| E. | Understand the commonly used Quantum Computing simulator. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand the concepts of Quantum Supremacy. |
| CO2 | Recall the various aspects of quantum computing. |
| CO3 | Understand the concept of Quantum Computing Algorithms. |
| CO4 | Develop and deploy a Quantum Computing Application on Qiskit. |
| CO5 | Deploy appropriate design choices when solving real-world quantum computing problems. |

**SYLLABUS**

**List of Programs as Assignments:**

Use IBMQiskit or equivalent and do the following using the Python Programming Language:

1. Write a program to display a "Welcome" Message.
2. Writeaprogramtoobtainmaximumbetweentwo numbers.
3. Writeaprogramtoobtainminimumbetweentwo numbers
4. Writeaprogramtoobtainfactorialofapositivenumber.
5. Writeaprogramtogeneratethefirstnnaturalnumbers
6. Writeaprogramtocheck whetheranumberisevennumberornot.
7. Writeaprogramtogeneratemultiplicationtableofauserdefinednumber.
8. Writeaprogramtocheckwhetheraninputnumberispositivenumberornot.
9. Writeaprogramtoobtainareaofarectangle.Takelengthandbreadthofrectanglefrom user.
10. Writeaprogramtoobtainareaofacircle.Take the radius of the circle from the user.

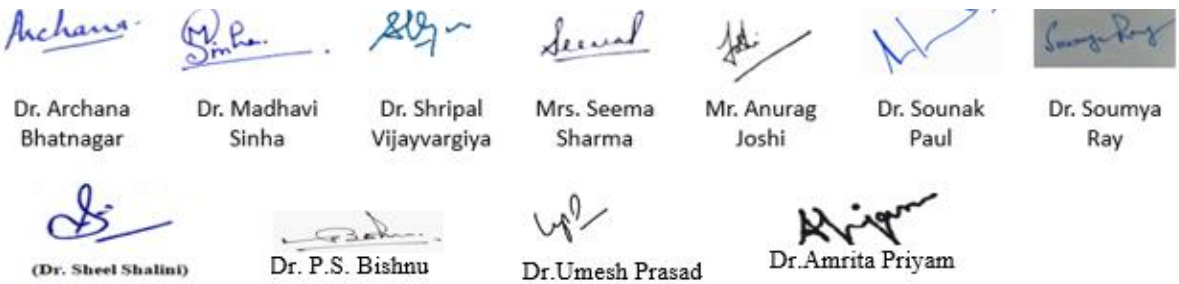
**TEXTBOOKS:**

2. Michael A. Nielsen, Isaac L. Chuang; Quantum Computation and Quantum Information; Cambridge University Press; 10th edition, 2010.

**REFERENCE BOOKS:**

1. JamesL.Weaver, Frank J. Harkins; QiskitPocketGuide: Quantum Development with Qiskit; O'Reilly, 1st Edition, 2022.

**Gaps in the Syllabus (to meet Industry/Profession requirements) POs met through Gaps in the Syllabus**



**Topics beyond the syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Second Quiz | 10 |
| Vivavoce | 20 |
| Daytodayperformance | 30 |
| ExamEvaluationperformance | 30 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**

| Course Outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | | | | 2 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | | 1 | 1 | 2 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | | 1 | 1 | | 1 | 1 | 2 | 3 | 2 | 3 |

**Course Delivery Levels 1, 2, or 3 as defined below:**
1: Slight (Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COS and Course Delivery (CD) Methods**

| CD Code | Course Delivery Methods | Course Outcome | Course Delivery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1,CD7,CD8 |
| CD2 | Tutorials/Assignments | CO2 | CD1,CD9 |
| CD3 | Seminars | CO3 | CD1,CD2,CD3 |
| CD4 | Mini Projects/Projects | CO4 | CD1,CD2 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1,CD2 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTEL Materials and Internet | | |
| CD9 | Simulation | | |

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| | | |
|---|---|---|
| **Course Code**<br>**Course Title** | | **: CN25449**<br>**PARALLEL ALGORITHM AND COMPUTATION** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class: BCA**
**Semester/Level: VIII/4**
**Branch: Bachelor of Computer Applications**

**CourseObjectives**
This course enables the students to:

| | |
|---|---|
| A. | Learnofbasicsofparallel computing. |
| B. | Learnabouttheapplicationsoftheparallelcomputingintoday'sworld. |
| C. | Learn basic techniques of parallel algorithms. |
| D. | Learn SIMD and MIMD algorithms. |
| E. | Learn about parallel algorithms for multiprocessors. |

**CourseOutcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand the concept of Parallel Computing. |
| CO2 | Know Application of Parallel processing and Data Parallelism. |
| CO3 | Understand the Performance Evaluation of Parallel Computers. |
| CO4 | Learnsortingandsearchingusingparallelalgorithm. |
| CO5 | Test different parallel algorithms. |

**Syllabus**

| **MODULE** | **(NO. OF LECTURE HOURS)** |
|---|---|
| **Module1**<br>DefinitionIntroduction to Parallel Computing, Basic Concepts about Programs /Process / Thread Concurrent Function, Parallel Execution. Parallel Processing Terminology-Contrasting Pipelining and Data Parallelism, Control Parallelism, Scalability, Control-Parallel Approach, Data-Parallel Approach with I/O. | **8** |
| **Module2**<br>Granularity Potential of Parallelism, Level of Parallel Processing, Applications of Parallel Processing, Scientific Applications, Database Query, conserving applications, AI applications. | **8** |
| **Module3**<br>PRAM Algorithm, Message Passing Programming, Shared memory, Message Passing Libraries, Data Parallel Programming, Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging two sorted lists. | **8** |

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| | |
|---|---|
| **Module4**<br>2DMeshSIMDModel-ParallelAlgorithmsforReduction-PrefixComputation -Selection-Odd-EvenMergeSorting-MatrixMultiplication, HypercubeSIMD Model - Parallel Algorithms for Selection-Odd-Even Merge Sort. | **8** |
| **Module5**<br>ElementaryParallelAlgorithm: ClassifyingMIMDAlgorithm, Reduction.Matrix Multiplication: Sequential Matrix Multiplication, Algorithms for Processor Array, Algorithms for Multiprocessors. | **8** |

**TEXTBOOKS:**

1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw-Hill Edition, Second edition, 2017.
2. V Rajaraman, C Siva Ram Murthy, "Parallel computers- Architecture and Programming ", PHI learning, 2016.

**REFERENCE BOOKS:**

1. M Sasikumar, Dinesh Shikhare and P Ravi Prakash, " Introduction to Parallel Processing", PHI learning, 2013.
2. H.Attiya & J. Welch- Distributed Computing- Fundamentals, Simulations and Advanced Topics, 2nd Edn., Wiley India Publication, New Delhi, 2006.
3. S.G.Akl, "The Design and Analysis of Parallel Algorithms", PHI,1989.

**Gaps in the Syllabus (to meet Industry/Profession requirements):**

1. Classificationbasedgrainsizeandinstructionlevelparallelism
2. Networkdesignissuesofinterconnected network

**POsmet through Gaps in the Syllabus**

**Topics beyond the syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus /Advanced topics/ Design**

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

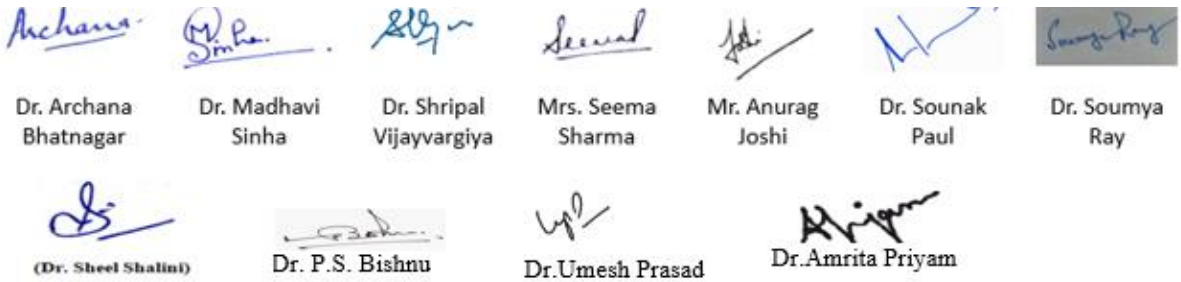
**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. 1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COs and Program Outcomes**



| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 2 |
| CO2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**Correlation Levels1, 2 or 3as defined below:**
1:Slight(Low) 2:Moderate (Medium) 3:Substantial(High)

**Mapping Between COS and Course Delivery (CD) Methods**

| CD Code | CourseDeliveryMethods | Course Outcome | CourseDelEvery Method Used |
|---|---|---|---|
| CD1 | Lecture by use of Boards/LCD Projectors | CO1 | CD1, CD2, CD3 |
| CD2 | Tutorials/Assignments | CO2 | CD1, CD2, CD5 |
| CD3 | Seminars | CO3 | CD1, CD2, CD3, CD5 |
| CD4 | Mini Projects/Projects | CO4 | CD1, CD2, CD3, CD5 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2, CD3, CD9 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self-learningsuchasuseofNPTELMaterials and Internets | | |
| CD9 | Simulation | | |

| | | |
|---|---|---|
| **CourseCode**<br>**CourseTitle** | | **: CN25451**<br>**: HIGH-PERFORMANCEBIGDATACOMPUTING** |
| **Pre-requisite(s)** | | **:** |
| **Co-requisite(s)** | | **:** |
| **Credits:3 L:3** | **T:0** | **P:0** |

**Class schedule per week** **03**
**Class** **: BCA**
**Semester/Level** **: VIII/4**
**Branch** **: Bachelor of Computer Applications**

**Course Objectives**
This course enables the students to:

| | |
|---|---|
| A. | Understand the principles of High-performance Computing. |
| B. | Understand the principles of parallel computing. |
| C. | Applyparallelprogrammingmodelstoreal-world problems. |
| D. | Evaluate the performance of parallel programs. |

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| | |
|---|---|
| E. | Select and use appropriate HPC systems and Software. |

**CourseOutcomes**

After the completion of this course, students will be able to:

| | |
|---|---|
| CO1 | Understand the principles, challenges, and applications of HPC. |
| CO2 | Apply the different parallel programming models. |
| CO3 | Design algorithms for parallel computation. |
| CO4 | Evaluate the performance of parallel programs. |
| CO5 | Usethedifferenttypesof HPCsoftware. |

**Syllabus**

| MODULE | (NO. OF LECTURE HOURS) |
|---|---|
| **Module1**<br>**Introduction to HPC:** history, applications, and Challenges<br>**Parallel architectures:** super scalar architectures, multi-core, multi-threaded, server, and cloud. | **8** |
| **Module2**<br>**ParallelProgrammingModels:** MPI, OpenMP, and CUDA<br>**Algorithms for parallel computation:** load balancing, data partitioning, and communication. | **8** |
| **Module3**<br>**Fundamental design issues in HPC:** Load balancing, scheduling, synchronization, and resource management; Operating systems for scalable HPC **Performance analysis of parallel algorithms:** different metrics, such as execution time, speedup, and efficiency. | **8** |
| **Module4**<br>**HPC systems and architectures:** supercomputers, clusters, and cloud computing platforms. | **8** |
| **Module5**<br>**HPC software:** different types of HPC software, such as compilers, libraries, and tools | **8** |

**TEXTBOOKS:**


1. Georg Hager Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.
2. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson Education, 2008.
3. D.Janakiram, Grid Computing, Tata McGraw-Hill,2005.
4. Vipin Kumar, Ananth Grama, Anshul Gupta, George Karypis. Introduction to Parallel Computing (2nd ed.). Pearson India. 2003.

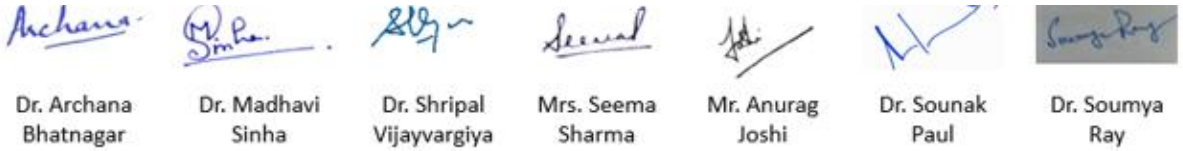

**REFERENCE BOOKS:**


1. B.Sosinsky, Cloud Computing Bible, Wiley, 2011.
2. B.Wilkinson, Grid Computing: Techniques and Applications, CRC Press,2009.
3. R.Buyya, C.Vecchiola, and S.T.Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.


**Gaps in the Syllabus (to meet Industry/ Profession requirements) POs met through Gaps in the Syllabus**

**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/ Advanced topics/Design.**



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## Course Outcome(CO) AttainmentAssessmentTools&EvaluationProcedure

**Direct Assessment**

| AssessmentTool | % Contribution during CO Assessment |
|---|---|
| First Quiz | 10 |
| Mid Semester Examination | 25 |
| Second Quiz | 10 |
| Teacher's Assessment | 5 |
| End Semester Examination | 50 |

**In Direct Assessment**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

**Mapping between COS and Program Outcomes**

| Course outcome | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
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| CD4 | Mini Projects/Projects | CO4 | CD1, CD2, CD5, CD8 |
| CD5 | Laboratory Experiments/Teaching Aids | CO5 | CD1, CD2, CD5, CD9 |
| CD6 | Industrial/Guest Lectures | | |
| CD7 | Industrial Visits/In-plant Training | | |
| CD8 | Self, learning such as the use of NPTEL Materials and the Internet | | |
| CD9 | Simulation | | |

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