# SACRED HEART COLLEGE (AUTONOMOUS), CHALAKUDY
# BACHELOR OF COMPUTER APPLICATIONS

## HONOURS

### (MAJOR, MINOR AND GENERAL FOUNDATION COURSES)

## SYLLABUS & MODEL QUESTION PAPERS

## w.e.f. 2024 admission onwards

## (FYUGP Regulations 2024)

# BACHELOR OF COMPUTER APPLICATIONS

# HONOURS

## (MAJOR, MINOR AND GENERAL FOUNDATION COURSES)

# SYLLABUS

## PROGRAMME OUTCOMES (PO):

At the end of the graduate programme at Sacred Heart College (Autonomous), Chalakudy, a student would:

| | |
|---|---|
| PO1 | Knowledge Acquisition:<br>Demonstrate a profound understanding of knowledge trends and their impact on the chosen discipline of study. |
| PO2 | Communication, Collaboration, Inclusiveness, and Leadership:<br>Become a team player who drives positive change through effective communication, collaborative acumen, transformative leadership, and a dedication to inclusivity. |
| PO3 | Professional Skills:<br>Demonstrate professional skills to navigate diverse career paths with confidence and adaptability. |
| PO4 | Digital Intelligence:<br>Demonstrate proficiency in varied digital and technological tools to understand and interact with the digital world, thus effectively processing complex information. |
| PO5 | Scientific Awareness and Critical Thinking:<br>Emerge as an innovative problem-solver and impactful mediator, applying scientific understanding and critical thinking to address challenges and advance sustainable solutions. |
| PO6 | Human Values, Professional Ethics, and Societal and Environmental Responsibility:<br>Become a responsible leader, characterized by an unwavering commitment to human values, ethical conduct, and a fervent dedication to the well-being of society and the environment. |
| PO7 | Research, Innovation, and Entrepreneurship:<br>Emerge as a researcher and entrepreneurial leader, forging collaborative partnerships with industry, academia, and communities to contribute enduring solutions for local, regional, and global development. |

## PROGRAMME SPECIFIC OUTCOMES (PSO):

At the end of the BCA Honours programme at Sacred Heart College (Autonomous), Chalakudy, a student would:

| | |
|---|---|
| PSO1 | Identify the relevance and applications of computers in other disciplines |
| PSO2 | Understand the concepts of system architecture, hardware, software and network configuration |
| PSO3 | Acquire logical thinking and problem-solving skills to find solutions in the software domain |
| SO4 | Design, analyse and develop code-based solutions for the algorithms |
| PSO5 | Address the industry demands and assimilate technical, logical and ethical skills needed for the industry |
| PSO6 | Adapt to emerging trends and tackle the challenges in the software field. |

# BCA (HONOURS) PROGRAMME
# COURSE STRUCTURE

**Single Major**

| Semester | Course Code | Course Title | Total Hours | Hours/ Week | | | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | T | P | T | | Internal | External | Total |
| 1 | BCA1CJ101 | Core Course 1 in Major<br>Fundamentals of Computers and Computational Thinking | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA1CJ 102/ BCA1MN 101 | Core Course 2 in Major<br>Mathematical Foundation for Computer Applications | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA1CJ 103/ BCA1MN 102 | Core Course 3 in Major<br>Discrete Structures for Computer Applications | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA1FM 105 | MDC/MDE – 1<br>Digital Marketing | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | BCA1FS111 | Skill Enhancement Course 1<br>Introduction to Computers and Office Automation | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | ENG1FA101(2) | Ability Enhancement Course 1<br>English | 60 | 2 | 2 | 4 | 3 | 25 | 50 | 75 |
| | | Ability Enhancement Course 2<br>Additional Language | 45 | 3 | 0 | 3 | 0 | - | - | - |
| | | **Total** | | **25** | | | **21** | | | **525** |
| 2 | BCA2CJ101 | Core Course 4 in Major<br>Fundamentals of Programming (C Language) | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA2CJ102/ BCA2MN 101 | Core Course 5 in Major<br>Statistical Foundation for Computer Applications | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA2CJ103/ BCA2MN102 | Core Course 6 in Major<br>Numerical Analysis and Optimization Techniques | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA2FS112 | Skill Enhancement Course 2<br>Data Analysis using Spread Sheet | 60 | 2 | 2 | 4 | 3 | 25 | 50 | 75 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ENG2FA103(2) | Ability Enhancement Course 3<br>English | 60 | 2 | 2 | 4 | 3 | 25 | 50 | 75 |
| | | Ability Enhancement Course 4<br>Additional Language | 45 | 3 | 0 | 3 | - | - | - | - |
| | | **Total** | | **24** | | | **18** | | | **450** |
| 3 | BCA3CJ201 | Core Course 7 in Major<br>Data Structures using C | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA3CJ202 | Core Course 8 in Major<br>Computer Networks | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA3CJ203/<br>BCA3MN201 | Core Course 9 in Major<br>Introduction to Data Science | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA3CJ204/<br>BCA3MN202 | Core Course 10 in Major<br>Foundations of Artificial Intelligence | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA3FS113 | Skill Enhancement Course 3<br>Website Designing using Content Management System | 60 | 2 | 2 | 4 | 3 | 25 | 50 | 75 |
| | | MDC/MDE 2 – (E/AL)<br>Kerala Knowledge System | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | | **Total** | | **25** | | | **22** | | | **550** |
| 4 | BCA4CJ205 | Core Course 11 in Major<br>Database Management System | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA4CJ206 | Core Course 12 in Major<br>Python Programming | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA4CJ207 | Core Course 13 in Major<br>Software Engineering | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA4CJ208 | Core Course 14 in Major<br>Automation and Robotics | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA4FV108 | Value-Added Course 1<br>Introduction to Cyber Laws | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | ENG4FV109(2) | Value-Added Course 2<br>English | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | | **Total** | | **24** | | | **22** | | | **550** |
| 5 | BCA5CJ301 | Core Course 15 in Major<br>Object Oriented Programming (Java) | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA5CJ302 | Core Course 16 in Major<br>Progressive Web Application using PHP | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA5CJ303 | Core Course 17 in Major<br>Digital Fundamentals and Computer Organization | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | BCA5EJ301(X) | Elective Course 1 in Major | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA5EJ302(X) | Elective Course 2 in Major | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA5FS114 | Skill Enhancement Course 4<br>Professional Skill Development for IT Career Excellence | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | BCA5FS115 | Skill Enhancement Course<br>Internship 1 | - | - | | | 4 | 100 | - | 100 |
| | | Audit Course 1 | - | - | | | - | - | - | - |
| | | **Total** | | **25** | | | **27** | | | **675** |
| 6 | BCA6CJ304/<br>BCA8MN304 | Core Course 18 in Major<br>Introduction to AI and ML | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA6CJ305/<br>BCA8MN305 | Core Course 19 in Major<br>Principles of Operating System | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA6EJ303(X) | Elective Course 3 in Major | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA6EJ304(X) | Elective Course 4 in Major | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA6FV110 | Value-Added Course 2<br>Business Intelligence and Innovation | 45 | 3 | 0 | 3 | 3 | 25 | 50 | 75 |
| | BCA6FS 116 | Skill Enhancement Course<br>Project 1 | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | | Audit Course 2 | - | - | | | - | - | - | - |
| | | **Total** | | **25** | | | **23** | | | **575** |
| **Total Credits for Three Years** | | | | | | | **133** | | | **3325** |
| 7 | BCA7CJ401 | Core Course 20 in Major<br>Advanced Data Structures and Algorithms | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA7CJ402 | Core Course 21 in Major<br>Data Science Programming using R | 75 | 3 | 2 | 5 | 4 | 30 | 70 | 100 |
| | BCA7EJ401(X) | Elective Course 5 in Major | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA7EJ402(X) | Elective Course 6 in Major | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA7EJ403(X) | Elective Course 7 in Major (in Honours with Research Programme) | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA7OE401(X) | Open Elective in Major (in Honours programme) | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA7FS117 | Skill Enhancement Course<br>Internship 2 | - | - | | | 4 | 100 | - | 100 |
| | | **Total** | | **22** | | | **24** | | | **600** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | BCA8EJ404(X) | Elective Course 8 in Major (in Honours Programme) | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA8EJ405(X) | Elective Course 9 in Major (in Honours Programme) | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA8EJ406(X) | Elective Course 10 in Major (in Honours Programme) | 60 | 4 | 0 | 4 | 4 | 30 | 70 | 100 |
| | BCA8FS118 | Skill Enhancement Course<br>Project 2 (in Honours Programme) | 120 | 8 | 0 | 8 | 8 | 60 | 140 | 200 |
| | OR (instead of Elective Course 8– 10 in Major | | | | | | | | | |
| | BCA8FS119 | Skill Enhancement Course<br>Research Project<br>(in Honours with Research Programme) | 300 | 20 | 0 | 20 | 20 | 150 | 350 | 500 |
| | | **Total** | | **20** | | | **20** | | | **500** |
| **Total Credits for Four Years** | | | | | | | **177** | | | **4425** |

## Note

1. Core Courses 2, 5, & 9 can be offered to students of other Major disciplines as Minor courses of Group 1, and Core courses 3, 6 &10 can be offered to them as Minor courses of Group II. 1. Core Courses 18 & 19 can be offered to eighth semester students of other Major disciplines as Minor courses.
2. There will be no pathway for BCA students.
3. Students from other disciplines can choose Minor Groups in BCA.
4. If a student from other department chooses Minor Group I in BCA, then the title of the Minor will be **Data Science**.
5. If a student from other department chooses Minor Group II in BCA, then the title of the Minor will be **Artificial Intelligence**.
6. If a student from other department chooses two Minor groups in BCA (Major with Minor Pathway), then the title of the Minor will be **Data Science and Artificial Intelligence**.

## Audit Courses

There are four mandatory Audit Courses or zero-credit courses that the students must attend in different semesters. Two of them are Ability Enhancement Courses offered by Additional Languages in the first and second semesters. The other two are Discipline Specific Elective courses in the fifth and sixth semesters. Students need to complete 75% attendance in Ability Enhancement Courses offered by Additional Languages in the first and second semesters, but need not appear for the internal and external evaluation of these courses. Discipline Specific Elective courses in the fifth and sixth semesters are not meant for class room study. The students can choose any course in Computer Science/Application/IT discipline and attend these courses online in platforms like SWAYAM, MOOC etc.

# CREDIT DISTRIBUTION

| Semester | Major Core Courses | Major DSE | General Foundation Courses | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | AEC | MDC/ MDE | VAC | SEC | Internship/ Project | |
| 1 | 4+4+4 | | 3 | 3 | | 3 | - | 21 |
| 2 | 4+4+4 | | 3 | | | 3 | - | 18 |
| 3 | 4+4+4+4 | | | 3 | | 3 | - | 22 |
| 4 | 4 + 4 + 4 +4 | | | | 3 + 3 | | - | 22 |
| 5 | 4 + 4 + 4 | 4 + 4 | | | | 3 | 4 | 27 |
| 6 | 4 + 4 | 4 + 4 | | | 3 | | 4 | 23 |
| **Total for Three Years** | **76** | **16** | **6** | **6** | **9** | **12** | **8** | **133** |
| 7 | 4 + 4 | 4 + 4 + 4 | | 4* | | | 4 | 24 |
| 8 | | 4 + 4 +4 | | | | | 8 / 20** | 20 |
| * Instead of Major DSE Course; **Instead of Three Major DSE & 8 Credit Project | | | | | | | | |
| **Total for Four Years** | **76+8 = 84** | **16+24= 40** | **6** | **6** | **9** | **12** | **20** | **177** |

# DISTRIBUTION OF MAJOR COURSES IN BCA

| Semester | Course Code | Course Title | Hours/ Week | Credits | |
|---|---|---|---|---|---|
| **1** | BCA1CJ101 | Core Course 1 in Major – Fundamentals of Computers and Computational thinking | 4 | 4 | |
| | BCA1CJ 102/ BCA1MN101 | Core Course 2 in Major- Mathematical Foundation for Computer Applications | 4 | 4 | |
| | BCA1CJ 103/ BCA1MN102 | Core Course 3 in Major -Discrete Structures for Computer Applications | 4 | 4 | |
| **2** | BCA2CJ101 | Core Course 4 in Major –Fundamentals of Programming (C Language) | 5 | 4 | |
| | BCA2CJ102/ BCA2MN101 | Core Course 5 in Major -Statistical Foundation for Computer Applications | 4 | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| | BCA2CJ103/ BCA2MN102 | Core Course 6 in Major - Numerical Analysis and Optimization Techniques | 4 | 4 | |
| **3** | BCA3CJ201 | Core Course 7 in Major – Data Structures using C | 5 | 4 | |
| | BCA3CJ202 | Core Course 8 in Major –Computer Networks | 5 | 4 | |
| | BCA3CJ203/ BCA3MN201 | Core Course 9 in Major - Introduction to Data Science | 4 | 4 | |
| | BCA3CJ204/ BCA3MN202 | Core Course 10 in Major - Foundations of Artificial Intelligence | 4 | 4 | |
| **4** | BCA4CJ205 | Core Course 11 in Major – Database Management System | 5 | 4 | |
| | BCA4CJ206 | Core Course 12 in Major – Python Programming | 5 | 4 | |
| | BCA4CJ207 | Core Course 13 in Major - Software Engineering | 4 | 4 | |
| | BCA4CJ208 | Core Course 14 in Major – Automation and Robotics | 4 | 4 | |
| **5** | BCA5CJ301 | Core Course 15 in Major – Object Oriented Programming in Java | 5 | 4 | |
| | BCA5CJ302 | Core Course 16 in Major – Progressive Web Application using PHP | 5 | 4 | |
| | BCA5CJ303 | Core Course 17 in Major – Digital Fundamentals and Computer Organization | 4 | 4 | |
| | BCA5EJ301(X) | Elective Course 1 in Major | 4 | 4 | |
| | BCA5EJ302(X) | Elective Course 2 in Major | 4 | 4 | |
| **6** | BCA6CJ304 | Core Course 18 in Major – Introduction to AI and ML | 5 | 4 | |
| | BCA6CJ305 | Core Course 19 in Major – Principles of Operating System | 5 | 4 | |
| | BCA6EJ303(X) | Elective Course 3 in Major | 4 | 4 | |
| | BCA6EJ304(X) | Elective Course 4 in Major | 4 | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| **Total for the Three Years** | | | | **92** | |
| **7** | BCA7CJ401 | Core Course 20 in Major – Advanced Data Structures and Algorithms | 5 | 4 | |
| | BCA7CJ402 | Core Course 21 in Major – Data Science Programming using R | 5 | 4 | |
| | BCA7EJ401(X) | Elective Course 5 in Major | 4 | 4 | |
| | BCA7EJ402(X) | Elective Course 6 in Major | 4 | 4 | |
| | BCA7EJ403(X) | Elective Course 7 (in Honours with Research Programme) | 4 | 4 | |
| | BCA7OE401(X) | Open Elective in Major (in Honours Programme) | 4 | 4 | |
| **8** | BCA8EJ404(X) | Elective Course 8 (in Honours Programme) | 4 | 4 | |
| | BCA8EJ405(X) | Elective Course 9 (in Honours Programme) | 4 | 4 | |
| | BCA8EJ406(X) | Elective Course 10 (in Honours Programme) | 4 | 4 | |
| **Total for the Four Years** | | | | 124 | |

## ELECTIVE COURSES IN BCA WITH SPECIALISATION

| Group No. | Sl. No. | Course Code | Title | Semester | Total Hrs | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal | External | Total |
| **1** | | **Image Processing** | | | | | | | | |
| | 1 | BCA5EJ301(1) | Fundamentals of Digital Image Processing | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 2 | BCA5EJ302(1) | Pattern Recognition | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 3 | BCA6EJ303(1) | Advanced Digital Image Processing and Computer Vision | 6 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 4 | BCA6EJ304(1) | Applied Digital Image Processing | 6 | 60 | 4 | 4 | 30 | 70 | 100 |
| **2** | | **Computer Networks** | | | | | | | | |
| | 1 | BCA5EJ301(2) | Wireless Communication | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 2 | BCA5EJ302(2) | Cryptography and Network Security | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 3 | BCA6EJ303(2) | Storage Area Network | 6 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 4 | BCA6EJ304(2) | Internet of Things | 6 | 60 | 4 | 4 | 30 | 70 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **3** | **Cloud Computing** | | | | | | | | | |
| | 1 | BCA5EJ301(3) | Cloud Computing | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 2 | BCA5EJ302(3) | Security and Privacy in Cloud | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 3 | BCA6EJ303(3) | Storage Technologies | 6 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 4 | BCA6EJ304(3) | Virtualization | 6 | 60 | 4 | 4 | 30 | 70 | 100 |
| **4** | **Data Science and AI** | | | | | | | | | |
| | 1 | BCA5EJ301(4) | Data Analytics and Visualization | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 2 | BCA5EJ302(4) | Knowledge Engineering | 5 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 3 | BCA6EJ303(4) | Advanced Python for Data Science | 6 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 4 | BCA6EJ304(4) | Neural Networks and Deep Learning | 6 | 60 | 4 | 4 | 30 | 70 | 100 |

## ELECTIVE COURSES IN BCA WITH NO SPECIALISATION

| Semester | Elective No. | Course Code | Title | Total Hrs | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Internal | External | Total |
| **7** | EL-5 | BCA7EJ401(1) | Theory of Computation | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA7EJ401(2) | Expert Systems and Fuzzy Logic | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA7EJ401(3) | Modern Cryptography | 60 | 4 | 4 | 30 | 70 | 100 |
| | EL-6 | BCA7EJ402(1) | Client Server Architecture | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA7EJ402(2) | Blockchain Technology | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA7EJ402(3) | Data Mining | 60 | 4 | 4 | 30 | 70 | 100 |
| | EL-7 | BCA7EJ403(1) | Research Methodology in Computer Science | 60 | 4 | 4 | 30 | 70 | 100 |
| | OE-1 | BCA7OE401(1) | Ethical Hacking | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA7OE401(2) | Cyber Forensics | 60 | 4 | 4 | 30 | 70 | 100 |
| **8** | EL-8 | BCA8EJ404(1) | Compiler Design | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA8EJ404(2) | Mixed Reality | 60 | 4 | 4 | 30 | 70 | 100 |
| | EL-9 | BCA8EJ405(1) | Mastering Java Web Development | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA8EJ405(2) | Social Network Analysis | 60 | 4 | 4 | 30 | 70 | 100 |
| | EL-10 | BCA8EJ406(1) | System Security | 60 | 4 | 4 | 30 | 70 | 100 |
| | | BCA8EJ406(2) | Parallel Computing | 60 | 4 | 4 | 30 | 70 | 100 |

# DISTRIBUTION OF GENERAL FOUNDATION COURSES IN BCA

| Sl. No. | Course Code | Course Title | Total Hours | Hours/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Internal | External | Total |
| **1** | BCA1FM 105 | MDC/MDE – 1<br>Digital Marketing | 45 | 3 | 3 | 25 | 50 | 75 |
| **2** | BCA4FV108 | Value-Added Course 1<br>Introduction to Cyber Laws | 45 | 3 | 3 | 25 | 50 | 75 |
| **3** | BCA6FV110 | Value-Added Course 2<br>Business Intelligence and Innovation | 45 | 3 | 3 | 25 | 50 | 75 |
| **4** | BCA1FS111 | Skill Enhancement Course 1<br>Introduction to Computers and Office Automation | 45 | 3 | 3 | 25 | 50 | 75 |
| **5** | BCA2FS112 | Skill Enhancement Course 2<br>Data Analysis using Spread Sheet | 60 | 4 | 3 | 25 | 50 | 75 |
| **6** | BCA3FS113 | Skill Enhancement Course 3<br>Website Designing using Content Management System | 60 | 4 | 3 | 25 | 50 | 75 |
| **7** | BCA5FS114 | Skill Enhancement Course 4<br>Professional Skill Development for IT Career Excellence | 45 | 3 | 3 | 25 | 50 | 75 |
| 8 | BCA5FS115 | Internship | 60 | - | 4 | 100 | | 100 |
| 9 | BCA6FS116 | Project Implementation | 60 | 4 | 4 | 30 | 70 | 100 |
| 10 | BCA7FS117 | Internship | 60 | - | 4 | 100 | | 100 |
| 11 | BCA8FS118/<br>BCA8FS119 | Project<br>(in Honours Programme)/<br>Research Project<br>(in Honours with Research | 200/<br>500 | 8/20 | 8/20 | 60/ 150 | 140/<br>350 | 200/<br>500 |

# GROUPING OF MINOR COURSES IN BCA

**For Other Departments**

**(**Title of the Minor: **Data Science and Artificial Intelligence)**

| Group No. | Sl. No. | Course Code | Title | Semester | Total Hrs | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal | External | Total |
| 1 | | **Data Science** | | | | | | | | |
| | 1 | BCA1MN 101 | Mathematical Foundation for Computer Applications | 1 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 2 | BCA2MN 101 | Statistical Foundation for Computer Applications | 2 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 3 | BCA3MN201 | Introduction to Data Science | 3 | 60 | 4 | 4 | 30 | 70 | 100 |
| 2 | | **Artificial Intelligence** | | | | | | | | |
| | 1 | BCA1MN 102 | Discrete Structures for Computer Applications | 1 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 2 | BCA2MN 102 | Numerical Analysis and Optimization Techniques | 2 | 60 | 4 | 4 | 30 | 70 | 100 |
| | 3 | BCA3MN202 | Foundations of Artificial Intelligence | 3 | 60 | 4 | 4 | 30 | 70 | 100 |

| Group No. | Sl. No. | Course Code | Title | Semester | Total Hrs | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal | External | Total |
| 1 | | **4th Year Minor Courses** | | | | | | | | |
| | 1 | BCA8MN304 | Introduction to AI and ML | 8 | 75 | 5 | 4 | 30 | 70 | 100 |
| | 2 | BCA8MN305 | Principles of Operating System | 8 | 75 | 5 | 4 | 30 | 70 | 100 |

# EVALUATION SCHEME

1. The evaluation scheme for each course contains two parts: internal evaluation (about 30%) and external evaluation (about 70%). Each of the Major and Minor courses is of 4-credits. It is evaluated for 100 marks, out of which 30 marks is from internal evaluation and 70 marks, from external evaluation. Each of the General Foundation course is of 3-credits. It is evaluated for 75 marks, out of which 25 marks is from internal evaluation and 50 marks, from external evaluation.
2. The 4-credit courses (Major and Minor courses) are of two types: (i) courses with only theory and (ii) courses with 3-credit theory and 1-credit practical.

- In 4-credit courses with only theory component, out of the total 5 modules of the syllabus, one open-ended module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated for 10 marks. The internal evaluation of the remaining 4 theory modules is for 20 marks.
- In 4-credit courses with 3-credit theory and 1-credit practical components, out of the total 5 modules of the syllabus, 4 modules are for theory and the fifth module is for practical. The practical component is internally evaluated for 20 marks. The internal evaluation of the 4 theory modules is for 10 marks.

**3.** 3-credit courses (General Foundational Courses) in BCA are of two types: (i) courses with only theory and (ii) courses with 2-credit theory and 1-credit practical.

- In 3-credit course with only theory out of the total 5 modules of the syllabus, one open-ended module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated for 5 marks. The internal evaluation of the remaining 4 theory modules is for 20 marks. theory
- In 3-credit courses with 2-credit and 1-credit practical components, out of the total 5 modules of the syllabus, 4 modules are for theory and the fifth module is for practicals. The practical component is internally evaluated for 15 marks. The internal evaluation of the 4 theory modules is for 10 marks.

| Sl. No. | Nature of the Course | | Internal Evaluation in Marks (about 30% of the total) | | External Exam on 4 modules (Marks) | Total Marks |
|---|---|---|---|---|---|---|
| | | | Open-ended module / Practical | On the other 4 modules | | |
| 1 | 4-credit course | only theory (5 modules) | 10 | 20 | 70 | 100 |
| 2 | 4-credit course | Theory (4 modules) + Practical | 20 | 10 | 70 | 100 |
| 3 | 3-credit course | only theory (5 modules) | 5 | 20 | 50 | 75 |
| 4 | 3-credit course | Theory (4 modules) + Practical | 15 | 10 | 50 | 75 |

## 1. MAJOR AND GENERAL FOUNDATION COURSES

### 1.1. INTERNAL EVALUATION OF THEORY COMPONENT

| Sl. No. | Components of Internal Evaluation of Theory Part of a Major / Minor Course | Internal Marks for the Theory Part of a Major / Minor Course of 4-credits | | | |
|---|---|---|---|---|---|
| | | Theory Only | | Theory + Practical | |
| | | 4 Theory Modules | Open-ended Module | 4 Theory Modules | Practical |
| 1 | Test paper/ Mid-semester Exam | 10 | 4 | 5 | - |
| 2 | Seminar/ Viva/ Quiz | 6 | 4 | 3 | - |
| 3 | Assignment | 4 | 2 | 2 | - |
| | | 20 | 10 | 10 | 20* |
| | Total | 30 | | 30 | |

* Refer the table in section 1.2 for the evaluation of practical component

### 1.2. EVALUATION OF PRACTICAL COMPONENT

The evaluation of practical component in Major and Minor courses is completely by internal evaluation.

- Continuous evaluation of practical by the teacher-in-charge shall carry a weightage of 50%.
- The end-semester practical examination and viva-voce, and the evaluation of practical records shall be conducted by the teacher in-charge and an internal examiner appointed by the Department Council.
- The process of continuous evaluation of practical courses shall be completed before 10 days from the commencement of the end-semester examination.
- Those who passed in continuous evaluation alone will be permitted to appear for the end-semester examination and viva-voce.

The scheme of continuous evaluation and the end-semester examination and viva-voce of practical component shall be as given below:

| Sl. No. | Evaluation of Practical Component of Credit-1 in a Major / Minor Course | Marks for Practical | Weightage |
|---|---|---|---|
| 1 | Continuous evaluation of practical/ exercise performed in practical classes by the students | 10 | 50% |
| 2 | End-semester examination and viva-voce to be conducted by teacher-in-charge along with an additional examiner arranged internally by the Department Council | 7 | 35% |
| 3 | Evaluation of the Practical records submitted for the end semester viva–voce examination by the teacher-in-charge and additional examiner | 3 | 15% |
| | Total Marks | 20 | |

### 1.3. EXTERNAL EVALUATION OF THEORY COMPONENT

External evaluation carries 70% marks. Examinations will be conducted at the end of each semester. Individual questions are evaluated in marks and the total marks are converted into grades by the University based on 10-point grading system (refer section 5).

**PATTERN OF QUESTION PAPER FOR MAJOR COURSES**

| Duration | Type | Total No. of Questions | No. of Questions to be Answered | Marks for Each Question | Ceiling of Marks |
|---|---|---|---|---|---|
| 2 Hours | Short Answer | 10 | 8 – 10 | 3 | 24 |
| | Paragraph/ Problem | 8 | 6 – 8 | 6 | 36 |
| | Essay | 2 | 1 | 10 | 10 |
| | | | | Total Marks | 70 |

**PATTERN OF QUESTION PAPER FOR GENERAL FOUNDATION COURSES**

| Duration | Type | Total No. of Questions | No. of Questions to be Answered | Marks for Each Question | Ceiling of Marks |
|---|---|---|---|---|---|
| 1.5 Hours | Short Answer | 10 | 8 – 10 | 2 | 16 |
| | Paragraph/ Problem | 5 | 4 – 5 | 6 | 24 |
| | Essay | 2 | 1 | 10 | 10 |
| | | | | Total Marks | 50 |

### 2. INTERNSHIP

- All students should undergo **TWO** Internship of 4-credits during the FIFTH and SEVENTH semesters in a firm, industry or organization, or training in labs with faculty and researchers of their own institution or other Higher Educational Institutions (HEIs) or research institutions.
- Internship can be for enhancing the employability of the student or for developing the research aptitude.
- Internship can involve hands-on training on a particular skill/ equipment/ software. It can be a short project on a specific problem or area. Attending seminars or workshops related to an area of learning or skill can be a component of Internship.
- A faculty member/ scientist/ instructor of the respective institution, where the student does the Internship, should be the supervisor of the Internship.

### 2.1. GUIDELINES FOR INTERNSHIP

1. Internship can be in Computer application or allied disciplines.
2. There should be minimum 120 hrs. of engagement from the student in the Internship.
3. Summer vacations and other holidays can be used for completing the Internship.
4. In BCA Honours programme, institute/ industry visit or study tour is a requirement for the completion of Internship. Visit to minimum one national research institute, research laboratory and place of scientific

importance should be part of the study tour. A brief report of the study tour has to be submitted with photos and analysis.

5. The students should make regular and detailed entries in to a personal log book through the period of Internship. The log book will be a record of the progress of the Internship and the time spent on the work, and it will be useful in writing the final report. It may contain experimental conditions and results, ideas, mathematical expressions, rough work and calculation, computer file names etc. All entries should be dated. The Internship supervisor should periodically examine and countersign the log book.
6. The log book and the typed report must be submitted at the end of the Internship.
7. The institution at which the Internship will be carried out should be prior-approved by the Department Council of the college where the student has enrolled for the UG (Honours) programme.

## 2.2. EVALUATION OF INTERNSHIP

- The evaluation of Internship shall be done internally through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG (Honours) programme.
- The credits and marks for the Internship will be awarded only at the end of. semester 5 & semester 7.
- The scheme of continuous evaluation and the end-semester viva-voce examination based on the submitted report shall be as given below:

| Sl. No. | Components of Evaluation of Internship | | Marks for Internship 4Credits | Weightage |
|---|---|---|---|---|
| 1 | Continuous evaluation of internship through interim presentations and reports by the committee internally constituted by the Department Council | Acquisition of skill set | 20 | 40% |
| 2 | | Interim Presentation and Viva-voce | 10 | |
| 3 | | Punctuality and Log Book | 10 | |
| 4 | Report of Institute Visit/ Study Tour | | 10 | 10% |
| 5 | End-semester viva-voce examination to be conducted by the committee internally constituted by the Department Council | Quality of the work | 12 | 35% |
| 6 | | Presentation of the work | 10 | |
| 7 | | Viva-voce | 12 | |
| 8 | Evaluation of the day-to-day records, the report of internship supervisor, and final report submitted for the end semester viva–voce examination before the committee internally constituted by the Department Council | | 16 | 15% |
| | Total Marks | | 10 | |

## 3. PROJECT

### 3.1 MINI PROJECT WORK (Skill Enhancement Course BCA6FS116)

A mandatory mini-project is scheduled in the VI Semester of the BCA Honours program. It is designed to cultivate students' research and software development skills. It will serve as a capstone experience, allowing students to bridge the gap between theoretical knowledge acquired in the classroom and its practical application to real-world problems.

**Project Selection and Approval:**

- Student groups (at most four members) can propose projects in Information Technology or related disciplines.
- Projects can be experimental (building a prototype), theoretical (a research paper), or computational (implementing an algorithm).
- Project proposals must be submitted for prior approval from the Department Council.
- Each project team will be assigned a project supervisor for guidance.

**Project Duration:**

- The mini-project duration is one semester.
- Minimum engagement: 90 hours per student.

**Project Deliverables:**

- Two hard copies and one softcopy of a well-structured typed report outlining:
  - Project objectives and requirements analysis
  - System design and architecture
  - Implementation details (including sample code snippets)
  - Test cases and results
  - Conclusion and future work
- A signed undertaking by the student declaring the originality of the work and the absence of plagiarism.
- A certificate from the project supervisor confirming the same.

**Evaluation Criteria and Rubrics:**

1. **Internal Evaluation (30%) -** Conducted by the project supervisor throughout the semester. This could involve:

- **Project Proposal and Planning (10%):**
  - Clarity of project goals and objectives.
  - Feasibility of the chosen approach.
  - Quality of system study/literature review and proposed methodology.
  - Clarity of project schedule and division of tasks within the team.
- **Project Progress and Implementation (10%):**
  - Regular code reviews and adoption of feedback provided by the supervisor.
  - Attendance and active participation in project meetings.
  - Completion of project milestones as planned.
  - Quality of code documentation and adherence to coding standards.

- **Interim Presentations (10%):**
  - Effectiveness of communication and presentation skills.
  - Clarity of technical details and progress made.
  - Ability to answer questions about the project effectively.

2. **External Evaluation (70%) -** Conducted by an internal examiner appointed by the Department Council and the project supervisor. This will take place at the end of the VI th semester:

- **Project Report (25%):**
  - Content: Completeness, organisation, clarity, and technical accuracy.
  - Structure: Introduction, System Design/literature review, methodology, implementation details, results, discussion, conclusion, future work, and references.
  - Presentation: Quality of writing, grammar, and formatting.
- **Project Demonstration (25%):**
  - Demonstration: Ability to showcase the functionality of the project or present the research findings effectively.
- **Viva-voce (20%):**
  - Viva-voce: Understanding of project concepts, ability to answer questions confidently, and critical thinking skills

### 3.2. PROJECT IN HONOURS PROGRAMME

- In Honours programme, the student has the option to do a Project of 8-credits along with three Core Courses in Major in semester 8.
- The Project can be done in the same institution or any other higher educational institution (HEI) or research centre.
- A faculty member of the respective institution, where the student does the Project, should be the supervisor of the Project.

### 3.3. PROJECT IN HONOURS WITH RESEARCH PROGRAMME

- Students who secure 75% marks and above (equivalently, CGPA 7.5 and above) cumulatively in the first six semesters are eligible to get selected to Honours with Research stream in the fourth year.
- In Honours with Research programme, the student has to do a mandatory Research Project of 20-credits in semester 8.
- The approved research centres of Sacred Heart College (Autonomous), Chalakudy or any other university/ HEI can offer the Honourswith Research programme. The departments in the affiliated colleges under Sacred Heart College (Autonomous), Chalakudy, whichare not the approved research centres of the University, should get prior approval from the University tooffer the Honours with Research programme. Such departments should have minimum one faculty member with Ph.D., and they should also have the necessary infrastruct-ure to offer Honours with Research programme.

- A faculty member of the University/ College with a Ph.D. degree can supervise the research project of the students who have enrolled for Honours with Research. One such faculty member can supervise maximum four students in Honours with Research stream.

### 3.4. GUIDELINES FOR THE PROJECT IN HONOURS PROGRAMME AND HONOURS WITH RESEARCH PROGRAMME

1. Project can be in Computer application or allied disciplines.
2. Project should be done individually.
3. Project work can be of experimental/ theoretical/ computational in nature.
4. There should be minimum 240 hrs. of engagement from the student in the Project work in Honours programme.
5. There should be minimum 360 hrs. of engagement from the student in the Project work in Honours with Research programme.
6. The various steps in project works are the following:
    - Wide review of a topic.
    - Investigation on a problem in systematic way using appropriate techniques.
    - Systematic recording of the work.
    - Reporting the results with interpretation in a standard documented form.
    - Presenting the results before the examiners.
7. During the Project the students should make regular and detailed entries in to a personal log book through the period of investigation. The log book will be a record of the progress of the Project and the time spent on the work, and it will be useful in writing the final report. It may contain experimental conditions and results, ideas, mathematical expressions, rough work and calculation, computer file names etc. All entries should be dated. The Project supervisor should periodically examine and countersign the log book.
8. The log book and the typed report must be submitted at the end of the Project. A copy of the report should be kept for reference at the department. A soft copy of the report too should be submitted, to be sent to the external examiner in advance.
9. It is desirable, but not mandatory, to publish the results of the Project in a peer reviewed journal.
10. The project report shall have an undertaking from the student and a certificate from the research supervisor for originality of the work, stating that there is no plagiarism, and that the work has not been submitted for the award of any other degree/ diploma in the same institution or any other institution.
11. The project proposal, institution at which the project is being carried out, and the project supervisor should be prior-approved by the Department Council of the college where the student has enrolled for theUG (Honours) programme.

### 3.5. EVALUATION OF PROJECT

- The evaluation of Project will be conducted at the end of the eighth semester by both internal and external modes.

- The Project in Honours programme will be evaluated for 200 marks. Out of this, 60 marks is from internal evaluation and 140 marks, from external evaluation.
- The Project in Honours with Research programme will be evaluated for 500 marks. Out of this,150 marks is from internal evaluation and 350 marks, from external evaluation.
- The internal evaluation of the Project work shall be done through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG (Honours) programme. 30% of the weightage shall be given through this mode.
- The remaining 70% shall be awarded by the external examiner appointed by the University.
- The scheme of continuous evaluation and the end-semester viva-voce of the Project shall be as given below:

| Components of Evaluation of Project | Marks for the Research Project (Honours with Research) | Marks for the Optional Project (Honours) | Weightage |
|---|---|---|---|
| | 20 Credits | 8 Credits | |
| Continuous evaluation of project work through interim presentations and reports by the committee internally constituted by the Department Council | 150 | 60 | 30% |
| End-semester viva-voce examination to be conducted by the external examiner appointed by the university | 250 | 100 | 50% |
| Evaluation of the day-to-day records and project report submitted for the end-semester viva–voce examination conducted by the external examiner | 100 | 40 | 20% |
| Total Marks | 500 | 200 | |

**INTERNAL EVALUATION OF PROJECT**

| Sl. No | Components of Evaluation of Project | Marks for the Research Project (Honours with Research programme) 20 credits | Marks for the Optional Project (Honours programme) 8 credits |
|---|---|---|---|
| 1 | Skill in doing project work | 50 | 20 |
| 2 | Interim Presentation and Viva-Voce | 35 | 15 |
| 3 | Punctuality and Log book | 35 | 15 |
| 4 | Scheme/ Organization of Project Report | 30 | 10 |
| | Total Marks | 150 | 60 |

**EXTERNAL EVALUATION OF PROJECT**

| Sl. No | Components of Evaluation of Project | Marks for the Research Project (Honours with Research | Marks for the Optional Project (Honours |
|---|---|---|---|

| | | programme)<br>20 credits | programme)<br>8 credits |
|---|---|---|---|
| 1 | Content and relevance of the Project, Methodology, Quality of analysis, and Innovations of Research | 100 | 40 |
| 2 | Presentation of the Project | 75 | 30 |
| 3 | Project Report (typed copy), Log Book and References | 100 | 40 |
| 4 | Viva-Voce | 75 | 30 |
| | Total Marks | 350 | 140 |

## 5. LETTER GRADES AND GRADE POINTS

- Mark system is followed for evaluating each question.
- For each course in the semester letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given below.
- The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester.
- The Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.
- Only the weighted grade point based on marks obtained shall be displayed on the grade card issued to the students.

**LETTER GRADES AND GRADE POINTS**

| Sl. No. | Percentage of Marks (Internal & External Put Together) | Description | Letter Grade | Grade Point | Range of Grade Points | Class |
|---|---|---|---|---|---|---|
| 1 | 95% and above | Outstanding | O | 10 | 9.50 – 10 | First Class with Distinction |
| 2 | Above 85% and below 95% | Excellent | A+ | 9 | 8.50 – 9. 49 | |
| 3 | 75% to below 85% | Very Good | A | 8 | 7.50 – 8.49 | |
| 4 | 65% to below 75% | Good | B+ | 7 | 6.50 – 7.49 | First Class |
| 5 | 55% to below 65% | Above Average | B | 6 | 5.50 – 6.49 | |
| 6 | 45% to below 55% | Average | C | 5 | 4.50 – 5.49 | Second Class |
| 7 | 35% to below 45% aggregate (internal and external put together) with a minimum of 30% in external valuation | Pass | P | 4 | 3.50 – 4.49 | Third Class |
| 8 | Below an aggregate of 35% or below 30% in external evaluation | Fail | F | 0 | 0 – 3.49 | Fail |
| 9 | Not attending the examination | Absent | Ab | 0 | 0 | Fail |

- When students take audit courses, they will be given Pass (P) or Fail (F) grade without any credits.
- The successful completion of all the courses and capstone components prescribed for the three-year or four-year programme with 'P' grade shall be the minimum requirement for the award of UG Degree or UG Degree (Honours) or UG Degree (Honours with Research), as the case may be.

**5.1. COMPUTATION OF SGPA AND CGPA**

- The following method shall be used to compute the Semester Grade Point Average (SGPA):

  The SGPA equals the product of the number of credits (Ci) with the grade points (Gi) scored by a student in each course in a semester, summed over all the courses taken by a student in the semester, and then divided by the total number of credits of all the courses taken by the student in the semester,

  $$\text{i.e. SGPA (Si)} = \Sigma i\ (Ci \times Gi) / \Sigma i\ (Ci)$$

  where Ci is the number of credits of the $i^{th}$ course and Gi is the grade point scored by the student in the $i^{th}$ course in the given semester. Credit Point of a course is the value obtained by multiplying the credit (Ci) of the course by the grade point (Gi) of the course.

**ILLUSTRATION – COMPUTATION OF SGPA**

| **Semester** | **Course** | **Credit** | **Letter Grade** | **Grade point** | **Credit Point** (Credit x Grade) |
|---|---|---|---|---|---|
| I | Course 1 | 3 | A | 8 | 3 x 8 = 24 |
| I | Course 2 | 4 | B+ | 7 | 4 x 7 = 28 |
| I | Course 3 | 3 | B | 6 | 3 x 6 = 18 |
| I | Course 4 | 3 | O | 10 | 3 x 10 = 30 |
| I | Course 5 | 3 | C | 5 | 3 x 5 = 15 |
| I | Course 6 | 4 | B | 6 | 4 x 6 = 24 |
| | Total | 20 | | | 139 |
| | SGPA | | | | 139/20 = 6.950 |

- The Cumulative Grade Point Average (CGPA) of the student shall be calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students.

  CGPA for the three-year programme in CUFYUGP shall be calculated by the following formula.

  CGPA for the four-year programme in CUFYUGP shall be calculated by the following formula.
- The SGPA and CGPA shall be rounded off to three decimal points and reported in the transcripts.
- Based on the above letter grades, grade points, SGPA and CGPA, the University shall issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

# Major Courses

## Semester I

### BCA1CJ101 - Fundamentals of Computers and Computational Thinking

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA1CJ101 | | | | |
| Course Title | Fundamentals of Computers and Computational Thinking | | | | |
| Type of Course | Major | | | | |
| Semester | I | | | | |
| Academic Level | 100 - 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Fundamentals of electronic components<br>2. Basic mathematical operations | | | | |
| Course Summary | This course provides a comprehensive overview of computing, covering historical milestones, hardware components, software systems, and computational thinking principles. Students will explore the evolution of computing systems, from early pioneers to modern processors and quantum units. The curriculum delves into hardware intricacies, software distinctions, and essential concepts in computer science, emphasizing problem-solving skills and algorithmic thinking. Practical aspects include hands-on experiences with hardware assembling, operating system installation, algorithm and flowchart visualization. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Develop a foundational knowledge of computing systems, encompassing their historical development, evolutionary milestones, and the notable contributions of key figures in the field. | U | F | Instructor-created exams / Quiz |
| CO2 | Acquire familiarity with diverse hardware components constituting a computer system. | U | C | Practical Assignment / Observation of Practical Skills |
| CO3 | Gain practical expertise by engaging in hands-on activities focused on the installation and configuration of diverse hardware components within a computer system. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO4 | Explore the spectrum of software types, and actively participate in the | Ap | P | Practical Assignment / |

| | | | | |
|---|---|---|---|---|
| | partitioning, installation, and configuration of operating systems to cultivate a comprehensive understanding of software systems. | | | Observation of Practical Skills |
| CO5 | Develop a foundational understanding of computer science as a discipline, examining problems through the lens of computational thinking and cultivating analytical skills to address challenges in the field. | An | C | Instructor-created exams / Quiz |
| CO6 | Represent complex problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of various software tools. | Ap | P | Practical Assignment / Observation of Practical Skills |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **History and Evolution of Computing System** | | **10** | **15** |
| | 1 | **Evolution of Computers** – History, Generations | 2 | |
| | 2 | **Overview of Computer System**- Von Neumann Model, Number Systems (Binary, Hexa, Octal, Decimal) | 2 | |
| | 3 | **Number Conversion and Digital Codes** - Conversion from one number system to another, Digital Codes (Gray, Excess-3, BCD) | 2 | |
| | 4 | **Pioneers and Contributors of Computing Systems** - First Mechanical computer - Charles Babbage, Stored-Program Architecture - John von Neumann, Turing machine - Alan Turing, First General-Purpose Electronic Digital Computer - John Mauchly and J. Presper Eckert, Artificial Intelligence- John McCarthy (Contributions only). | 2 | |
| | 5 | **Computing Systems: Past to Present** - Single Core, Dual-Core and Multi-Core Processors, Graphics Processing Unit (GPU), Accelerated Processing Unit, Quantum Processing Units (QPU) (Concept only). | 2 | |
| **II** | **Hardware** | | **11** | **20** |
| | 6 | **Electronic Components** – Active Components - Diode, Transistor, Integrated Circuits (Definition, Symbol and Function). | 1 | |
| | 7 | **Electronic Components** - Passive Components – Resistors, Capacitors, Inductors (Definition, Symbol and Function). | 1 | |
| | 8 | **Motherboard Components –** CPU and Cooling Fan, RAM, Expansion Slots (PCIe), Input/Output Ports, Chipset (Concept only). | 2 | |
| | 9 | **Motherboard Components –** BIOS/UEFI Chip, SATA/NVMe Slots, Network Interface, Ports- Ethernet, VGA, HDMI, USB (Concept only). | 3 | |
| | 10 | **Computer Components** – SMPS, Motherboard, Storage Devises | 2 | |

| | | | | |
|---|---|---|---|---|
| | | (HDD, SSD, NVMe (Concept only). | | |
| | 11 | **Computer Components** – RAM (DRAM, SRAM, DDR SDRAM), ROM, Cache (Concept only). | 2 | |
| **III** | **Software** | | **12** | |
| | 12 | **Software** - Application Software, System Software, Examples | 2 | |
| | 13 | **Operating System** – Need of OS, Types – Proprietary and Open Source, Hardware Software Compatibility, POST, Booting. | 4 | |
| | 14 | **OS Installation –** Bootable Media, UEFI/Legacy BIOS, Disk Partitioning, Dual Booting, Boot Manager – BOOTMGR, Grub, File Systems- FAT, NTFS, ext4. | 4 | **15** |
| | 15 | **Device Drivers –** Need of Device Drivers, Driver Interactions (Basic concept only). | 2 | |
| **IV** | **Computer Science and Computational Thinking** | | **15** | |
| | 16 | **Computer Science**- Role of Computer Science in the Modern Era. | 1 | |
| | 17 | **Problem Solving -** Defining the Problem, Systematic Approach. | 2 | **20** |
| | 18 | **Computational Thinking** – Problem Decomposition, Pattern Identification, Abstraction, Generalization. | 2 | |
| | 19 | **Logical Thinking** – Inductive and Deductive Reasoning, Logical Expressions. | 2 | |
| | 20 | **Algorithmic Thinking** – Intuition vs Precision, Defining algorithms. | 2 | |
| | 21 | **Algorithm** – Need of Algorithm, Qualities of a Good Algorithm, Examples. | 3 | |
| | 22 | **Flowchart** - Flowchart Symbols, Examples. Raptor. | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | | Strictly do the following activities from the Lab.<br><br>1. Identify, categorize and list out specifications of given **electronic components**.<br>2. Identify and list out specifications of given **motherboard components**.<br>3. Identify and Describe various **ports and connectors on motherboard**.<br>4. Installation of various **components on motherboard** (Processor, Fan, Heat Sink, RAM etc.)<br>5. Hands-on experience in **assembling and disassembling** a computer system (SMPS, Motherboard, Storage Device etc.).<br>6. Accessing and configuring the **Basic Input/Output System (BIOS) or Unified Extensible Firmware Interface (UEFI)** settings.<br>7. Preparation of **Bootable media** with software like ***Rufus***.<br>**8.** Check the hardware compatibility and **Install operating system** (single booting) on given computer.<br>**9.** Check the hardware compatibility and **Install operating systems** (dual booting – Windows and Linux) on given computer.<br><br>**Develop algorithms and implement** the solutions using ***RAPTOR*** flowchart execution tool for the following problems. | | |

| | | | | |
|---|---|---|---|---|
| | | 10. Read and print a number.<br>11. Read the price of three items and print the total bill amount.<br>12. Read ages of two persons and print the elder one.<br>13. Read the number of units of electricity consumed and print the bill amount for various slabs.<br>14. Read a year and check whether it is a leap year.<br>15. Print first N numbers (using loop). | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | - | - | - | 1 | | | | | | |
| CO 2 | 1 | 3 | - | - | 1 | - | | | | | | |
| CO 3 | 1 | 3 | - | - | 2 | 2 | | | | | | |
| CO 4 | 1 | 3 | - | - | 2 | 2 | | | | | | |
| CO 5 | 2 | 1 | 3 | 1 | 1 | - | | | | | | |
| CO 6 | 2 | 1 | 3 | 2 | 2 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | ✓ | ✓ |
| CO 3 | ✓ | ✓ | ✓ | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 5 | | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | ✓ | ✓ |

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1. Gary B. Shelly, Thomas J. Cashman, and Misty E. Vermaat. “Introduction to Computers”, Cengage Learning, 2008.

2. Pradeep K. Sinha and Priti Sinha, Computer Fundamentals: Concepts, Systems & Applications. BPB Publications.

3. Kevin Wilson, Computer Hardware: The Illustrated Guide to Understanding Computer Hardware. Amazon Digital Services LLC – KDP, 2018.

4. John Hanna, OS Installation 101: A Step-by-Step Approach for Newbies.

5. David Riley and Kenny Hunt, Computational thinking for modern solver, Chapman & Hall/CRC, 2014.

6. R.G. Dromey, How to solve it by Computer, PHI, 2008.

## BCA1CJ102/BCA1MN 101 - Mathematical Foundation for Computer Applications

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA1CJ102/BCA1MN 101 | | | | |
| Course Title | Mathematical Foundation for Computer Applications | | | | |
| Type of Course | Major/Minor (A1) | | | | |
| Semester | I | | | | |
| Academic Level | 100-199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic Mathematics is required (Algebra, Arithmetic) | | | | |
| Course Summary | This course provides a fundamental exploration of mathematical concepts essential for computer science. Students will explore into key topics including Linear Algebra, Differential and Integral Calculus. The course aims to equip students with the mathematical tools and reasoning skills necessary for creating and analyzing algorithms, understanding and solving computational problems in various areas of computer science like Data science, Artificial Intelligence. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Reflect the concept of matrices and determinants as a way to depict and streamline mathematical ideas toperform basic operations. | U | C | Instructor- created exams / Quiz/Assignment/ Seminar |
| CO2 | Able to find the inverse of square matrices using different methods and demonstrate a solid understanding of eigen values. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO3 | Proficiency in solving linear equations using different techniques and understanding the geometric interpretation of solutions. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO4 | Gain proficiency in representing vectors geometrically and algebraically, understanding vector addition, dot and cross products. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO5 | Able to apply differential and integral calculus to various functions encountered in computer applications such as polynomials, exponentials and logarithmic functions. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO6 | Represent various mathematical problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools. | U, Ap | C, P | Practical Assignment / Observation of Practical Skills |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Contents | Hrs (48+12) | Marks |
|---|---|---|---|---|
| I | | **Matrices and Determinants** | **14** | **18** |
| | 1 | Matrices: Definition, Order of a matrix, Types of matrices | 2 | |
| | 2 | Operations on matrices: Addition, Subtraction, Multiplication | 3 | |
| | 3 | Properties of matrix: Various kind of Matrices, Transpose of a matrix | 2 | |
| | 4 | Elementary Transformations of Matrices and Rank of Matrices | 2 | |

| | | | | |
|---|---|---|---|---|
| | 5 | Symmetric and Skew Symmetric Matrices | 2 | |
| | 6 | Determinants, Minors, Cofactors, Inverse of a matrix | 3 | |
| **II** | **Linear Algebra and Vector Calculus** | | **12** | **18** |
| | 7 | Linear Independence: Characteristic equations, | 1 | |
| | 8 | Eigen values, Eigen Vector | 2 | |
| | 9 | Solving system of linear equations: Gauss Elimination Method, Gauss Jordan method, Gauss Siedel Methods | 3 | |
| | 10 | Vectors: Definition Magnitude of a vector, Types of Vectors, Vector addition | 2 | |
| | 11 | Dot products and Cross products | 2 | |
| | 12 | Vectors in 2- and 3-space | 2 | |
| **III** | **Differentiation** | | **11** | **17** |
| | 13 | Limits; Definition (concept only), Derivative of a Point, Derivative at Function | 2 | |
| | 14 | Differentiation: Definition, Differentiation from first principle, Differentiation of important function | 2 | |
| | 15 | Product rule, Quotient rule | 3 | |
| | 16 | Derivative of function of a function | 2 | |
| | 17 | Logarithmic differentiation | 2 | |
| **IV** | **Integration** | | **11** | **17** |
| | 18 | Integration: Integral as Anti-derivative, Indefinite integral & constant of integration | 2 | |
| | 19 | Fundamental theorems, Elementary Standard results | 2 | |
| | 20 | Integral of different functions, Integration by Substitution | 3 | |
| | 21 | Definite Integrals, Properties of definite integrals | 2 | |
| | 22 | Evaluation of Definite Integrals by Substitution | 2 | |
| **V** | **Open Ended Module – Application Level** | | **12** | |
| | 1 | Discuss topics from the following:<br>• Differential Equation.<br>• Concept of First Order ODE's.<br>• Concept of Second Order ODE's.<br>• Application of Logarithm.<br>• Combinatorics.<br>• Trigonometric concept.<br>• Applications of Matrices in various field of computer like image processing, cryptography etc.<br>• Real-world examples for using eigen values and eigen vectors.<br>• Vectors assist in GPS technology to provide accurate | 10 | |

| | | | | |
|---|---|---|---|---|
| | | navigation data.<br>• 3D vectors enhancement in virtual reality experiences.<br>• Discuss the importance of differentiation and integration in various computer fields, such as Machine Learning, Robotics, Quantum Computing, etc. | | |
| | 2 | Case Study | 2 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 1 | 1 | - | - | | | | | | |
| CO 2 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 3 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 4 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 5 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 6 | 2 | - | 2 | 2 | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | ✓ | ✓ |

**References:**


1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley
2. Higher Engineering Mathematics, John Bird, Elsevier Direct
3. Skills in Mathematics: Algebra, S.K.Goyal
4. Higher Engineering Mathematics, B S Grewal, Khanna Publishers
5. Higher Engineering Mathematics, Ramana, Tata McGraw Hill
6. Engineering Mathematics, P Kandasamy, S. Chand Group
7. Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, 2023.
8. Kenneth Hoffman, Ray Kunze, " Linear Algebra", Prentice Hall India Learning, 2015.
9. Gilbert Strang, "Calculus", Wellesley-Cambridge Press, 2023.
10. Joseph Edwards, "Differential Calculus for Beginners", Arihant Publications, 2016.
11. Joseph Edwards, "Integral Calculus for Beginners", Arihant Publications, 2016.


## BCA1CJ103/BCA1MN 102 - Discrete Structures for Computer Applications

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA1CJ103/BCA1MN 102 | | | | |
| Course Title | Discrete Structures for Computer Applications | | | | |
| Type of Course | Major/Minor (B1) | | | | |
| Semester | I | | | | |
| Academic Level | 100-199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | No pre-requisites required | | | | |
| Course Summary | This course provides a foundational understanding of essential concepts that are fundamental to computer science and various branches of mathematics. The course explores topic related to Propositional Logic, Sets and Relations, Graphs and Trees. This helps the students to equip with the analytical and problem-solving skills necessary for applications in computer science and algorithm design. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Acquire a comprehensive understanding of propositional logic and its applications, with a focus on constructing and interpreting truth tables. | U | C | Instructor- created exams / Quiz/Assignment/ Seminar |
| CO2 | Able to proficiently define and manipulate sets, analyse relations and functions and their representation by Venn diagrams | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO3 | Acquire a basic understanding of graph theory including representations, types of graphs, their properties such as connectivity, cycles, paths and degrees. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO4 | Able to demonstrate a deep understanding of advanced graph theory concepts, focusing on Euler's graph, Hamiltonian graphs, Isomorphism and Homeomorphism. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO5 | Able to proficiently understand the tree data structures, spanning trees and associated algorithms for solving problems such as Prim's and Kruskal. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO6 | Represent various mathematical problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools. | U, Ap | C, P | Practical Assignment / Observation of Practical Skills |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Contents | Hrs (48+12) | Mark |
|---|---|---|---|---|
| I | | **Mathematical Logic** | **09** | **17** |
| | 1 | Propositional Logic: Definition, Logical Operators (Negation, Disjunction, Conjunction, Implication, Biconditional), Truth Table | 2 | |
| | 2 | Law of Logic: Tautology, Contradiction, Contingency, Logical equivalence | 2 | |
| | 3 | Algebra of Propositions, Solving logic with and without truth table | 2 | |

| | | | | |
|---|---|---|---|---|
| | 4 | Validity of Arguments, Logical implication | 2 | |
| | 5 | Quantifiers: Universal and Existential | 1 | |
| **II** | **Set Theory and Relations** | | **12** | **17** |
| | 6 | Set Theory: Definition, Concept of Set Theory, Cardinality, Types of sets | 1 | |
| | 7 | Properties of Set: Subsets, Power set, Venn Diagrams, Set operations, Partition | 2 | |
| | 8 | Relation: Definition and Examples, Type of Relations with example, | 2 | |
| | 9 | Equivalence relation, Equivalence Class and Di-Graph and problems | 3 | |
| | 10 | Functions: Introduction, type of function, Composition function | 2 | |
| | 11 | One-to-one function, Onto function, One-to-one correspondence | 2 | |
| **III** | **Introduction to Graphs** | | **16** | **20** |
| | 12 | Graph: Definition, Properties of Graph, Simple Graph, Regular Graph, Null Graph, Subgraph and Isomorphism | 2 | |
| | 13 | Walk, Path, Trail, Circuit, Cycle, Complete Graph, Hand-Shaking Theorem | 2 | |
| | 14 | Connected Graph, Complete Graph, Euler Graph, Hamiltonian graph, Travelling Sales Man Problem, Operations on Graph, Homeomorphism | 3 | |
| | 15 | Planar Graph, Kuratowski's two graph, Matrix Representation of Graph | 3 | |
| | 16 | Bi-Partite Graph, Graph colouring, Chromatic number | 2 | |
| | 17 | Basic theorems on Graph, Hand-Shaking Theorem | 4 | |
| **IV** | **Trees and Applications** | | **11** | **16** |
| | 18 | Tress: Definition, Properties, Pendant vertex, Distance, Eccentricity and Center of Tress | 2 | |
| | 19 | Rooted Tress, Binary Tress and Its Properties | 2 | |
| | 20 | Basic Theorems on Tress | 3 | |
| | 21 | Minimum Spanning Tree: Definition, Prim's Algorithm and Kruskal's Algorithm (Algorithm and Problem Based) | 2 | |
| | 22 | Cut-Set and Cut-Vertices, Connectivity of Graph and Weighted Graph | 2 | |

| | | | | |
|---|---|---|---|---|
| V | **Open-Ended Module – Application Level** | | **12** | |
| | 1 | Discuss topics from the following:<br>• First Order Logic.<br>• Application of Logic in Intelligence System.<br>• Set theory in Computer Applications.<br>• POSET and Hasse Diagram.<br>• Di-Graph of the relation.<br>• Application of Graphs like Königsberg Bridge Problem, Utilities Problem, Electrical Network Problems, Seating Problem.<br>• Different type of Binary Tree and their applications.<br>• BFS and DFS Algorithm.<br>• Directed Graphs and Directed Trees.<br>• Application of Graphs in Computer fields.<br>• Basic Concept of Group and Ring. | 10 | |
| | 2 | Case Study | 2 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 1 | 1 | - | - | | | | | | |
| CO 2 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 3 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 4 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 5 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 6 | 2 | - | 2 | 2 | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | ✓ | ✓ |

**References:**


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3. Kenneth A Ross, Charles R B Wright, "Discrete Mathematics", 5th Edition, Pearson Education India, 2012.
4. Swapan Kumar Sarkar, "Discrete Mathematics", 9th Edition, S Chand & Co Ltd, 2016.
5. Elements of Discrete Mathematics, C. L. Liu, TMH Edition
6. Discrete Mathematical Structures with applications to Computer Science, J.K. Tremblay and R Manohar, McGraw Hill
7. Discrete mathematical Structures, Kolman, Busby, Ross, Pearson
8. Graph theory, Harry, F., Addison Wesley.


# Semester II

## BCA2CJ101 - Fundamentals of Programming (C Language)

| | |
|---|---|
| Programme | BCA |
| Course Code | BCA2CJ101 |
| Course Title | Fundamentals of Programming (C Language) |
| Type of Course | Major |
| Semester | II |
| Academic Level | 100 – 199 |

| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
|---|---|---|---|---|---|
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Fundamentals of Algorithms and Flowcharts<br>2. BCA1CJ104 – Fundamentals of Computers and Computational Thinking | | | | |
| Course Summary | The objectives of this course are to make the student understand programming language, programming, concepts of Loops, reading a set of Data, stepwise refinement, Functions, Control structure, Arrays, Structures, Unions, and Pointers. After completion of this course the student is expected to analyze the real-life problem and write a program in 'C' language to solve the problem. The main emphasis of the course will be on problem solving aspect i.e. developing proper algorithms. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Remember the program structure of C with its syntax and semantics | U | C | Instructor-created exams / Quiz |
| CO2 | Use the various constructs of a programming language viz. conditional, iteration and recursion. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO3 | Implement the algorithms in C language. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO4 | Use simple data structure like array in solving problems. | Ap | C | Practical Assignment / Observation of Practical Skills |
| CO5 | Handling pointers and memory management functions in C. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO6 | Develop efficient programs for solving a problem. | Ap | P | Viva Voce |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to C Language** | | **10** | |
| | 1 | History of C, Importance of C, and sample programs | 2 | |
| | 2 | Character set, Tokens, Constants, Variables, and Data types | 2 | |
| | 3 | Operators - Arithmetic, Relational, logical, assignment, increment, decrement, conditional, bitwise and special | 3 | |

| | | | | |
|---|---|---|---|---|
| | | operators. Arithmetic expressions, operator precedence, type conversions, mathematical functions | | |
| | 4 | Managing Input and Output Operators: Reading and writing a character, formatted input, formatted output. | 3 | |
| **II** | **Decision Making Branching and Looping** | | **10** | |
| | 5 | Decision making with If - simple If, If else, nested If else, else If ladder | 3 | |
| | 6 | Switch statement, conditional operator, Goto statement | 2 | |
| | 7 | Loops: while, do while, for statements and nested loops | 3 | |
| | 8 | Jumps in loops – break, continue | 2 | |
| **III** | **Arrays and Functions** | | **15** | |
| | 9 | One dimensional array – declaration, initialization and accessing | 2 | |
| | 10 | Two-dimensional array – declaration, initialization and accessing | 2 | |
| | 11 | Multi dimensional array, dynamic array | 1 | |
| | 12 | Strings – Reading, Writing. Arithmetic operations on characters, Comparisons and string handling functions | 2 | |
| | 13 | Functions – Need, Elements of user defined functions and definition | 2 | |
| | 14 | Return values and their types, function call and declaration, call by value and call by reference | 2 | |
| | 15 | Categories of functions, Nesting of functions | 1 | |
| | 16 | Recursion and command line arguments | 1 | |
| | 17 | Passing arrays to functions and passing strings to functions | 2 | |
| **IV** | **Storage Classes, Structure and Union, Pointers** | | **10** | |
| | 18 | Storage classes – The scope, visibility and lifetime of variables. Auto, Extern, Static and Register storage classes. Storage classes in a single source file and multiple source files | 2 | |
| | 19 | Structure and Union - Defining, giving values to members, initialization and comparison of structure variables, arrays of structure, arrays within structures, structures within structures, structures and functions, unions | 2 | |
| | 20 | Pointers definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor | 2 | |
| | 21 | Pointers and arrays, pointers and functions, pointers and structure | 2 | |
| | 22 | Dynamic memory allocation and memory management functions | 2 | |
| **V** | **Hands-on Problem-Solving Using C<br>Practical Applications, Case Study and Course Project** | | **30** | |
| | 1 | Implement the following:<br>**1. Variables, Data types, Constants and Operators:**<br>1.Evaluation of expression ex: ((x+y) ^2 * (x+z))/w<br>2.Temperature conversion problem (Fahrenheit to Celsius)<br>3.Program to convert days to months and days (Ex: 364 days = 12 months and 4 days)<br>4. Salesman salary (Given: Basic Salary, Bonus for every item sold, commission on the total monthly sales) | 30 | |

| | | | | |
|---|---|---|---|---|
| | | **2. Decision making (Branch / Loop) Statements:**<br>5.Solution of quadratic equation<br>6.Maximum of three numbers<br>7.Calculate Square root of five numbers (using goto statement)<br>8.Pay-Bill Calculation for different levels of employee (Switch statement)<br>9. Fibonacci series<br>10.Armstrong numbers<br>11.Pascal ‘s Triangle<br>**3. Arrays, Functions and Strings:**<br>12. Prime numbers in an array<br>13. Sorting data (Ascending and Descending)<br>14.Matrix Addition and Subtraction<br>15.Matrix Multiplication<br>16.Transpose of a matrix<br>17Function with no arguments and no return value<br>18. Functions with argument and return value<br>19.Functions with argument and multiple return values<br>20.Function that convert lower case letters to upper case<br>21. Factorial using recursion.<br>22. Perform String Operations using Switch Case<br>23. Largest among a set of numbers using command line argument<br>**4. Structures and Union:**<br>24. Structure that describes a hotel (name, address, grade, avg room rent, number of rooms) Perform some operations (list of hotels of a given grade etc.)<br>25. Using Pointers in Structures.<br>26. Cricket team details using Union.<br>**5. Pointers:**<br>27.Evaluation of Pointer expressions<br>28.Function to exchange two pointer values<br>29. Reverse a string using pointers<br>30.Insertion, deletion, and searching in an array | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | - | 1 | 1 | - | - | | | | | | |
| CO 2 | - | 1 | 2 | 2 | - | - | | | | | | |
| CO 3 | - | 1 | 3 | 3 | - | - | | | | | | |
| CO 4 | - | 1 | 2 | 2 | - | - | | | | | | |
| CO 5 | - | 2 | 2 | 2 | - | - | | | | | | |
| CO 6 | - | 1 | 3 | 3 | 1 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**References:**


1. Kernighan, B. W., & Ritchie, D. M. (1988). The C Programming Language (2nd ed.). Prentice Hall. ISBN: 978-0131103627
2. King, K. N. (2008). C Programming: A Modern Approach (2nd ed.). W. W. Norton & Company. ISBN: 978-0393979503
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5. Griffiths, D., & Griffiths, D. (2012). Head First C. O'Reilly Media. ISBN: 978-1449399917
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## BCA2CJ102/BCA2MN101 - Statistical Foundation for Computer Applications

| | |
|---|---|
| Programme | BCA |
| Course Code | BCA2CJ102/BCA2MN101 |
| Course Title | Statistical Foundation for Computer Applications |
| Type of Course | Major/Minor (A2) |
| Semester | II |

| | | | | | |
|---|---|---|---|---|---|
| Academic Level | 100 – 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. A strong foundation in algebra<br>2. Fundamentals of Set theory and logic | | | | |
| Course Summary | The course on probability and statistics covers fundamental topics including descriptive statistics (measures of central tendency and dispersion), probability theory (events, sample spaces, probabilitylaws, random variables, and distributions), inferential statistics (regression analysis), and applications in various fields such as science, engineering, economics, and social sciences, emphasizing critical thinking, data analysis, and problem-solving skills. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Apply fundamental statistics concepts | Ap | C | Quizzes, Homework, Exams |
| CO2 | Analyze data using descriptive statistics | An | P | Projects, Midterm, Exams |
| CO3 | Perform regression analysis | An | P | Projects, Exams |
| CO4 | Apply probability and statistics in real-world situations | Ap | C | Projects, Exams |
| CO5 | Develop critical thinking and problem-solving skills | E | M | Homework, Projects |
| CO6 | Communicate statistical findings effectively | E | M | Presentations, Reports |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| I | | **DESCRIPTIVE STATISTICS** | **10** | **15** |
| | 1 | Concept of primary and secondary data, Methods of collection | 2 | |

| | | | | |
|---|---|---|---|---|
| | 2 | Measures of central tendencies (Mean, Median, Mode, HM, GM) | 4 | |
| | 3 | Measures of dispersion, Relative Measures and Absolute Measures | 2 | |
| | 4 | Range, Quartile deviation, Mean deviation, standard deviation, Variance | 2 | |
| **II** | **STATISTICAL INFERENCE AND REGRESSION ANALYSIS** | | **10** | **15** |
| | 5 | Principles of Least Squares and Fitting of Stright Line | 3 | |
| | 6 | Point estimation: maximum likelihood estimation (MLE), method of moments. Confidence intervals for population parameters. | 2 | |
| | 7 | Pearson's Coefficient of Correlation and Rank Correlation | 2 | |
| | 8 | Simple linear regression and multiple linear regression. Logistic regression for classification problems. | 3 | |
| **III** | **PROBABILITY THEORY** | | **12** | **20** |
| | 9 | Random experiment, Sample point, Sample Space | 1 | |
| | 10 | Events, Operation of events (Union, Intersection, Complement of Events) | 2 | |
| | 11 | Exclusive and exhaustive events, equally likely events with examples | 1 | |
| | 12 | Classical approach to probability, Axiomatic definitions of probability, Simple problems | 2 | |
| | 13 | Theorems of probability - Addition Theorem, Multiplication Theorem | 2 | |
| | 14 | Conditional probability | 2 | |
| | 15 | Inverse probability | 1 | |
| | 16 | Baye's Theorem | 1 | |
| **IV** | **ADVANCED PROBABILITY DISTRIBUTION** | | **16** | **20** |
| | 17 | Discrete and continuous random variables and probability distribution | 3 | |
| | 18 | Binomial distribution: Definition, Expectation, Variance, Moment Generating Function and Problems | 2 | |
| | 19 | Poisson distribution: Definition, Expectation, Variance, Moment Generating Function and Problems | 2 | |
| | 20 | Normal distribution: Definition, Expectation, Variance, Moment Generating Function, Standard normal curve and Problems | 3 | |
| | 21 | Testing of Hypothesis: General principles of testing, Two types of errors | 3 | |
| | 22 | Type of Testing: T-Test, ANOVA-Test, Chi-square test (Concept Only) | 3 | |
| | **Open Ended module- Application Level** | | **12** | |
| | 1 | Discuss topics from the following:<br>• Reliability and Validity of Different Data Sources.<br>• Highlighting the use of Measures Mean, Median and Mode in Real-World Scenarios. | 10 | |

| | | | | |
|---|---|---|---|---|
| **V** | | • Significance of Measures of Dispersion in Data Analysis.<br>• Interpretation of EDA plots.<br>• Importance of Correlation and Regression in numerous Computer fields.<br>• Problem sets involving real-world applications of probability theorems.<br>• Central Limit Theorem.<br>• Real-world scenario of Binomial, Poisson and Normal Distribution.<br>• Difference between of Binomial, Poisson and Normal Distribution.<br>• Advanced Concept of T-Test, ANOVA-Test, Chi-square test, Z-Test.<br>• Markov-Chain-Montee-Carlo Method and it's use. | | |
| | 2 | Case Study | 2 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | - | 1 | 1 | 1 | | | | | | |
| CO 2 | 1 | 3 | - | - | 1 | - | | | | | | |
| CO 3 | 1 | 3 | - | - | 2 | 2 | | | | | | |
| CO 4 | 1 | 3 | - | - | 2 | 2 | | | | | | |
| CO 5 | 2 | 1 | - | 1 | 1 | - | | | | | | |
| CO 6 | 2 | 1 | 1 | 2 | 2 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | ✓ | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**


1. Introduction to Mathematical Statistics, Hogg R V Craig A T, Macmillan
2. Mathematical Statistics, Freund J E, Waple R E, Prentice Hall of India.
3. Probability and Statistics for Engineers, Miller I Freund J E, Prentice Hall of India.
4. Statistics for Management, Levin R I, Prentice Hall of India
5. Introduction to Mathematical Statistics, Hogg R V Craig A T, Macmillan
6. Mathematical Statistics, Freund J E, Waple R E, Prentice Hall of India.
7. Probability and Statistics for Engineers, Miller I Freund J E, Prentice Hall of India.
8. Gupta, S.P. Statistical Methods. Sultan Chand and Sons: New Delhi.
9. Mood, A.M., Graybill, F.A and Boes, D.C. Introduction to Theory of Statistics. 3rd Edition Paperback – International Edition.
10. Mukhopadhyay, P. Mathematical Statistics. New central Book Agency (P) Ltd: Calcutta
11. Probability and Statistics for Computer Scientists by Michael Baron


## BCA2CJ103/BCA2MN102 - Numerical Analysis and Operations Research

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA2CJ103/BCA2MN102 | | | | |
| Course Title | Numerical Analysis and Operations Research | | | | |
| Type of Course | Major/Minor (B2) | | | | |
| Semester | II | | | | |
| Academic Level | 100 – 199 | | | | |
| Course Details | Credit | Lecture | Tutorial | Practical | Total |

| | | | | | |
|---|---|---|---|---|---|
| | | per week | per week | per week | Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Understanding of algebraic concepts, including solving equations and inequalities.<br>2. Familiarity with the concept of derivatives and integrals. | | | | |
| Course Summary | This course covers foundational concepts in numerical methods and operations research, emphasizing error analysis and solution techniques for algebraic and transcendental equations. Students will develop skills in polynomial interpolation, numerical integration, and explore fundamental principles of operations research, including linear programming. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Develop a solid foundation in numerical methods, acquiring the skills to analyze and solve algebraic and transcendental equations, and gaining a practical understanding of the sources and management of errors in numerical computations. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | Cultivate both a comprehensive grasp and practical proficiency in polynomial interpolation techniques, alongside acquiring expertise in numerical methods for the solution of definite integrals. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Establish a robust groundwork in Operations Research, nurturing a discerning capability to critically evaluate its applications across diverse problem-solving scenarios. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Develop expertise in Linear Programming, mastering the art of employing sophisticated optimization techniques for the effective resolution of Linear Programming problems. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Impart a comprehensive understanding of transportation problems and cultivate an appreciation for the methods used in finding basic feasible solutions. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Develop proficiency in addressing assignment problems and employ the method to attain optimal solutions, providing a holistic skill set for logistical optimization. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Numerical Analysis I** | | **10** | **15** |
| | 1 | Errors in numerical calculations - Sources of errors | 1 | |
| | 2 | Solution of Algebraic and Transcendental Equations - Bisection method | 3 | |
| | 3 | Method of false position | 3 | |
| | 4 | Newton Raphson method | 3 | |
| **II** | **Numerical Analysis II** | | **12** | **15** |
| | 5 | Polynomial Interpolation - Lagrange interpolation | 3 | |
| | 6 | Newton's forward and backward difference interpolation | 3 | |
| | 7 | Numerical Solution of Definite Integral - Simpson's 1/3rd rule | 2 | |
| | 8 | Simpson's 3/8 Rule | 2 | |
| | 9 | Trapezoidal method | 2 | |
| **III** | **Operations Research I** | | **13** | **20** |
| | 10 | Introduction to Operations Research – Definition, Advantages and Limitations of Operations Research | 1 | |
| | 11 | Linear Programming Problem – Definition, Formulation of LPP, Feasible solution and Optimal solution | 2 | |
| | 12 | Dual of LPP | 2 | |
| | 13 | Graphical solution of LPP | 2 | |
| | 14 | Simplex Method | 3 | |
| | 15 | Big-M method | 3 | |
| **IV** | **Operations Research II** | | **13** | **20** |
| | 16 | Transportation Problem – Definition, Balanced and unbalanced Transportation problems | 1 | |
| | 17 | Finding basic feasible solutions – Northwest corner method | 2 | |
| | 18 | Least cost method | 1 | |
| | 19 | Vogel's approximation method | 2 | |
| | 20 | Optimized (MODI) method | 3 | |
| | 21 | Assignment model - Definition, Balanced and unbalanced Assignment problems | 1 | |
| | 22 | Hungarian method for optimal solution | 3 | |
| **V** | **Open Ended Module – Other Numerical Methods** | | **12** | |
| | 1 | • Any other two methods to solve Algebraic and Transcendental Equations<br>• Any other two methods for Polynomial Interpolation<br>• Any other two methods to solve Solution of Definite Integral<br>• Any other method to solve LPP | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | - | 1 | - | 3 | - | | | | | | |
| CO 2 | 1 | - | 1 | - | 3 | - | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 3 | 3 | - | 1 | - | 3 | - | | | | | | |
| CO 4 | 3 | - | 1 | - | 3 | - | | | | | | |
| CO 5 | 3 | - | 1 | - | 3 | - | | | | | | |
| CO 6 | 3 | - | 1 | - | 3 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall India.

2. E. Carl Froberg and Erik Carl Frhoberg, Introduction to Numerical Analysis, Addition Wesley.

3. Hamdy A. Taha, Operations Research an Introduction, Pearson Education Limited.

4. P. Sankara Iyer, Operations Research, Tata McGraw-Hill, 2008.

5. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Operations Research, Pearson Education, 2005.

# Semester III

## BCA3CJ201 - Data Structures using C

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA3CJ201 | | | | |
| Course Title | Data Structures using C | | | | |
| Type of Course | Major | | | | |
| Semester | III | | | | |
| Academic Level | 200 - 299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Fundamental Mathematics Concepts: Set, Functions, Logic<br>2. CSC2CJ101 – Fundamentals of Programming | | | | |
| Course Summary | This course explores implementations of linked list and array-based data structures, delving into the inner workings of basic data structures including lists, stacks, queues, trees, and graphs. | | | | |

**Course Outcomes (CO)**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Differentiate basic data structures (arrays, linked lists, stacks, queues) based on their characteristics, operations, and real-world applications. | U | C | Instructor-created exams / Quiz |
| CO2 | Perform basic operations (e.g., insertion, deletion, search) on fundamental data structures using a chosen programming language. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO3 | Identify the properties and applications of advanced data structures (trees, graphs). | Ap | P | Seminar Presentation / Group Tutorial Work |
| CO4 | Investigate the properties of various searching and sorting Techniques | U | C | Practical Assignment / Seminar |
| CO5 | Demonstrate critical thinking and problem-solving skills by applying data structures and algorithms to address complex computational challenges. | Ap | P | Viva Voce/ Observation of Practical Skills |
| CO6 | Implement and analyse different data structure algorithms (to solve practical problems. | Ap | P | Case study/ Project |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction to Data Structures and Basic Algorithms** | **9** | **15** |
| | 1 | Overview of Data Structures: Data type Vs. Data structure, ADT, Definition of Data structure, Data structure Classification – Linear, Non Linear (Array, Linked List, Stack, Queue, Tree, Graph) | 1 | |
| | 2 | Introduction to Arrays: Definition, Types (1 Dimensional, 2 Dimensional, Multi-Dimensional, Sparse matrix), Different Array Operations with Algorithm (insertion, deletion, traversal) | 3 | |
| | 3 | Structures and Self-referential structures | 1 | |
| | 4 | Introduction to Linked list: Definition, Types (Single linked list, Doublelinked list, Circular linked list- concept only). | 2 | |
| | 5 | Singly Linked List Operations with Algorithm (insertion, deletion, traversal) | 2 | |
| **II** | | **Stack and Queue** | **10** | **20** |
| | 6 | Introduction to Stack: Definition, stack operations with Algorithm, Applications: recursion, infix to postfix - example and Algorithm | 3 | |
| | 7 | Implementation of Stack: using array (overflow & underflow) and Linkedlist (with algorithm) | 2 | |
| | 8 | Introduction to Queue: Definition, queue operations with Algorithm, Types: Double ended queue (Input Restricted and Output restricted), Circularqueue, Applications | 2 | |
| | 9 | Implementation of Queue: using array and Linked list (with algorithm) | 3 | |
| **III** | | **Non- Linear Data Structures** | **16** | **20** |
| | 10 | Introduction to Trees: Basic terminology, Types (Binary tree-complete,full, skewed etc., Expression Tree) | 2 | |
| | 11 | Properties of Binary tree, Applications. | 2 | |
| | 12 | Binary tree representations- using array and linked list | 2 | |
| | 13 | Operations on Binary tree- Insertion, Deletion, Traversal- inorder, preorder, postorder - (concepts with examples) | 3 | |
| | 14 | Algorithm of non-recursive Binary tree traversal | 3 | |
| | 15 | Introduction to Graph: Definition, Basic terminology, Types (Directed, Undirected, Weighted). | 2 | |
| | 16 | Graph representation –Adjacency list and Adjacency Matrix, Applications. | 2 | |
| **IV** | | **Sorting and Searching** | **10** | **15** |
| | 17 | Introduction to Sorting: Definition, Classification (Internal, External) | 1 | |
| | 18 | Internal Sorting Algorithms: Selection sort- Selection sort algorithm, Exchange sort- Bubble sort algorithm | 2 | |
| | 19 | External Sorting Algorithms: Merge sort- Demonstrate with example (NoAlgorithm needed) | 1 | |

| | | | | |
|---|---|---|---|---|
| | 20 | Advanced sorting Algorithm-: Quick sort- Demonstrate with example. (NoAlgorithm needed) | 1 | |
| | 21 | Introduction to Searching: Linear search and Binary search (Algorithm needed) with example. | 2 | |
| | 22 | Hashing: Hash Tables, Hash Functions, Different Hash Functions – Division method, Multiplication method, Mid square method, Folding Method, Collision and Collision resolution Techniques: Open hashing- Chaining, Closed hashing- Probing | 2 | |
| **V** | **Hands-on Programming in Data Structures: Practical Applications, Case Study and Course Project** | | **30** | |
| | 1 | **Implement the following:**<br>**1.** Basic Operations in a single linked list (Menu driven)<br>**2.** Sort the elements in given singly linked list<br>**3.** Stack using array.<br>**4.** Stack using Linked list<br>**5.** Queue using Array<br>**6.** Queue using Linked list<br>**7.** Sorting algorithms- Selection, Bubble Sort<br>**8.** Searching Algorithms- Linear and Binary search | 25 | |
| | 2 | Project/ Case study | 5 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | 1 | - | - | - | | | | | | |
| CO 2 | 2 | 1 | 2 | 3 | - | - | | | | | | |
| CO 3 | 2 | 1 | 2 | 3 | - | - | | | | | | |
| CO 4 | 2 | - | 2 | 3 | - | - | | | | | | |
| CO 5 | 1 | 1 | 2 | 3 | 1 | - | | | | | | |
| CO 6 | 1 | 1 | 3 | 3 | 1 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam

- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**References:**

1. Seymour Lipschutz, “Data Structures with C”, McGraw Hill Education (Schaum's Outline Series).
2. Reema Thareja, “Data Structures Using C”, Oxford University Press.

## BCA3CJ202 - Computer Networks

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA3CJ202 | | | | |
| Course Title | Computer Networks | | | | |
| Type of Course | Major | | | | |
| Semester | V | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1.Knowledge in Computer Organization and Architecture.<br>2.Knowledge in Operating System. | | | | |
| Course Summary | This course covers the concepts of data communication and computer networks. It comprises of the study of the standard models for the layered protocol architecture to communicate between autonomous computers in a network and also the main features and issues of communication protocols for different layers. Topics covered comprise of introduction to OSI and TCP/IP models also. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To understand the fundamentals of computer networks including concepts like data communication, network topologies and the reference models | U | C | Instructor-Create Exams or Quiz |
| CO2 | Proficiency in Transmission Media and Multiplexing Techniques: | A | P | Discussions and Quizzes |
| CO3 | To familiarise with the common networking protocols and standards | U | F | Instructor created exams or Home assignments |
| CO4 | Describe, analyse and compare different data link, network and transport layer protocols | A, E | P | Discussions, Quizzes |
| CO5 | Design/implement data link and network layer protocols in simulated networking environment | Ap | P | Viva Voce Observation of practical skills |
| CO6 | To understand the need of various Application layer protocols | U | M | Instructor Created - Exams, Assignments |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction to Computer networks and Network models** | **12** | **17** |
| | 1 | Types of computer networks, Internet, Intranet, Network topologies, Network classifications. | 2 | |
| | 2 | Network Architecture Models: Layered architecture approach, OSI Reference Model, TCP/IP | 2 | |
| | 3 | Physical Layer: Analog signal, digital signal, Analog to Digital, Digital to Analog, maximum data rate of a channel transmission | 4 | |
| | 4 | Transmission media (guided transmission media, wireless transmission, satellite communication). | 2 | |
| | 5 | multiplexing (frequency division multiplexing, time division multiplexing, wavelength division multiplexing | 2 | |
| **II** | | **Data Link Layer** | **11** | **18** |
| | 6 | Data link layer services, error-detection Types of errors, Single bit error and Burst error, Vertical redundancy check (VRC), longitudinal redundancy Check (LRC), Cyclic Redundancy Check (CRC), Check sum Error correction - Single bit error correction, Hamming code | 2 | |
| | 7 | Error correction techniques,<br>error recovery protocols (stop and wait, go back n, selective repeat), | 3 | |
| | 8 | Multiple access protocols, (TDMA/FDP, | 2 | |

| | | | | |
|---|---|---|---|---|
| | | CDMA/FDD/CSMA/CD, CSMA/CA), | | |
| | 9 | Datalink and MAC addressing, Ethernet, Polling | 1 | |
| | 10 | IEEE Standards- Wireless LANS, Ethernet, Bluetooth | 3 | |
| **III** | **Network layer** | | **11** | **18** |
| | 11 | Networking and Internetworking devices - Repeaters, Bridges, Routers, Gateways, Firewall | 2 | |
| | 12 | Logical addressing - IPv4 & IPv6 addresses, Network Address Translation (NAT), Internet protocols, internetworking,Datagram, | 2 | |
| | 13 | Transition from IPv4 to IPv6 | 1 | |
| | 14 | Address Mapping-Error reporting and multicasting - Delivery, | 2 | |
| | 15 | Forwarding and Routing algorithms, Distance Vector Routing, | 2 | |
| | 16 | Link State Routing. Dijkstra | 2 | |
| **IV** | **Transport Layer and Application layer** | | **11** | **17** |
| | 17 | Transport layer, Process-to-process Delivery: UDP, TCP | 2 | |
| | 18 | Congestion control and Quality of Service, | 2 | |
| | 19 | Domain Name Systems-Remote Login, Email | 2 | |
| | 20 | FTP, WWW, HTTP | 2 | |
| | 21 | Introductory concepts on Network management& Mail transfer: SNMP | 2 | |
| | 22 | SMTP | 1 | |
| **V** | **Hands-on Computer Networks: Practical Applications,** | | **30** | |
| | 1 | LAB1: identifying Networking Hardware components (Jacks, Cables, Tools)<br>Lab 2: IP address - configuring.<br>Lab3: Crimping<br>Lab 4: Configuring network host - setting hostname - assigning IP address<br>Lab 5: configuring the Network Interface card –<br>Lab 6: Setup a Wired LAN with more than two systems<br>Lab 7: Setup a Wireless LAN with more than two systems<br>Lab 8: Setting up Internet services File Transfer Protocol (FTP),<br>Lab 9: Simple Mail Transfer Protocol (SMTP) and Post Office Protocol (POP)<br>Lab 10: Setting up Intranet Services - Network File System (NFS), | 20 | |
| | 2 | Case study | 3 | |
| | 3 | **Capstone (/Course) Project:** Build a practical application using Wired Network | 7 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | - | - | - | - | | | | | | |
| CO 2 | 2 | 2 | 1 | - | - | - | | | | | | |
| CO 3 | - | 2 | 1 | - | - | - | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | - | 2 | 1 | 1 | 1 | - | | | | | | |
| CO 5 | 1 | 1 | 2 | 2 | - | - | | | | | | |
| CO 6 | 1 | 2 | 1 | 3 | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | ✓ | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | ✓ | | | ✓ |
| CO 5 | | ✓ | ✓ | ✓ |
| CO6 | | | ✓ | |

**References:**

1. Behurouz A Forozan, Introduction to Data Communications & Networking, TMH
2. Andrew S. Tanenbaum, Computer Networks, PHI
3. William Stallings, Data and Computer Communications, VIIth Edition, Pearson Education

# BCA3CJ203/BCA3MN201 - Introduction to Data Science

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA3CJ203/BCA3MN201 | | | | |
| Course Title | Introduction to Data Science | | | | |
| Type of Course | Major/Minor (A3) | | | | |
| Semester | III | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of computer science concepts.<br>2. Familiarity with data handling.<br>3. simple mathematical analysis. | | | | |
| Course Summary | Data science is the domain of study that deals with vast volumes of data using modern tools and techniques to find unseen patterns, derive meaningful information, and make business decisions. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Identify the relevance and applications of computers in other disciplines with various data science applications. | R | C | Assignment / Instructor-created exams / Quiz |
| CO2 | understanding of data science concepts and be capable of applying data science skills and interpret data science results | U | C | Assignment / Instructor-created exams / Quiz |
| CO3 | Acquire logical thinking about evolution of data science | U | C | Assignment / Instructor-created exams / Quiz |
| CO4 | How to use tools for acquiring, cleaning, analyzing, exploring, and visualizing data | Ap | P | Assignment / Instructor-created exams / Quiz |
| CO5 | Learn to make data-driven inferences and decisions | Ap | P | Assignment / Instructor-created exams / Quiz |
| CO6 | Able to perform data science processing, such as data import, data analysis, data visualization, and data modelling | Ap | P | Assignment / Instructor-created exams / Quiz |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| **I** | **Introduction to Data Science** | | **10** | **15** |
| | 1 | Introduction to Data Science-Definition | 2 | |
| | 2 | Evolution of Data Science | 2 | |
| | 3 | Data Science Roles | 3 | |
| | 4 | Application of data sciences. | 3 | |
| **II** | **Data Collection and Data Pre-Processing** | | **12** | **15** |
| | 5 | Data Collection Strategies | 2 | |
| | 6 | Data Pre-Processing Overview | 2 | |
| | 7 | Data Cleaning | 2 | |
| | 8 | Data Integration and Transformation | 3 | |
| | 9 | Data Reduction and Descretization | 3 | |
| **III** | **Data Analytics** | | **12** | **20** |
| | 10 | Descriptive Statistics | 2 | |
| | 11 | Mean, Standard Deviation | 2 | |
| | 12 | Skewness and Kurtosis | 2 | |
| | 13 | Box Plots | 2 | |
| | 14 | Pivot Table | 2 | |
| | 15 | Correlation Statistics | 2 | |
| **IV** | **Data Model Development and Evaluation** | | **14** | **20** |
| | 16 | Simple and Multiple Regression | 2 | |
| | 17 | Model Evaluation using Visualization | 2 | |
| | 18 | Residual plot and distributional plot | 2 | |
| | 19 | Prediction and Decision Making | 2 | |
| | 20 | Model Evaluation techniques- | 3 | |
| | 21 | Supervised learning techniques | 2 | |
| | 22 | unsupervised learning techniques | 1 | |
| **V** | • Out of samples evaluation metrics<br>• Cross validation in Model evaluation<br>• Over fitting and under fitting concepts<br>• Appropriate model selection.<br>• Prediction and decision-making concepts.<br>• Prediction by ridge regression. | | **12** | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | - | 1 | - | 2 | - | | | | | | |
| CO 2 | 3 | - | 1 | - | 1 | - | | | | | | |
| CO 3 | 3 | - | 2 | - | 1 | - | | | | | | |
| CO 4 | 2 | - | 2 | - | 2 | - | | | | | | |
| CO 5 | 1 | - | 2 | - | 2 | - | | | | | | |
| CO 6 | 1 | - | 2 | 1 | 2 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | | ✓ | ✓ | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |
| CO 5 | | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**


1. Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT, 2016.
2. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
4. Introduction to Data Science a Python approach to concepts, Techniques and Applications, Igual, L;Seghi', S. Springer, ISBN:978-3-319-50016-4 2.
5. Data Analysis with Python A Modern Approach, David Taieb, Packt Publishing, ISBN-9781789950069


## BCA3CJ204/BCA3MN202 - Foundations of Artificial Intelligence

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA3CJ204/BCA3MN202 | | | | |
| Course Title | Foundations Artificial Intelligence | | | | |
| Type of Course | Major/Minor (B3) | | | | |
| Semester | III | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | A course on Discrete Mathematics is recommended | | | | |
| Course Summary | This course provides an introduction to the field of Artificial Intelligence covering fundamental concepts, problem solving methods such as search algorithms and heuristics approaches and different knowledge representation techniques. The course addresses the ethical dimensions of AI and their societal impacts. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Able to gain insight into the evolution of key ideas and technologies by exploring the Artificial Intelligence history and its foundational concepts. | U | C | Instructor-created exams / Quiz/Assignment/ Seminar |
| CO2 | Able to acquire knowledge and skills to understand, design, implement intelligent agents to perceive, reason and act within their environments. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |

| | | | | |
|---|---|---|---|---|
| CO3 | Proficiency in various uninformed and informed search strategies along with constraint satisfaction problem solving methods. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO4 | Ability to design and implement logical agents and construct ontologies that capture the semantics of a domain, facilitating knowledge representation. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO5 | Understand the ethical considerations of AI and their societal impacts and gain insights into the future trajectory of AI by analysing the emerging trends. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO6 | Represent various AI problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools. | U, Ap | C, P | Practical Assignment / Observation of Practical Skills |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Contents | Hrs (48+12) | Marks |
|---|---|---|---|---|
| I | | **Introduction to AI** | **11** | **18** |
| | 1 | Artificial Intelligence: Definition and Applications | 2 | |
| | 2 | Foundations of Artificial Intelligence | 1 | |
| | 3 | History of Artificial Intelligence, State of the Art | 2 | |
| | 4 | Intelligent Agents: Agents and Environments | 1 | |
| | 5 | The Concept of Rationality, Nature of Environments: Specifying the Task Environment, Properties of Task Environment | 3 | |
| | 6 | Structure of Agents: Agent Programs, Simple Reflex Agent, Model Based Reflex Agent, Goal Based Agent, Utility Based Agent, Learning Agent (Concept Only, No Algorithm required) | 2 | |
| II | | **AI Problem Solving** | **15** | **20** |
| | 7 | Problem Solving Agents (Concept Only), Examples Problems: Toy problems, Real world problems | 3 | |
| | 8 | Solutions for searching: Tree Search and Graph Search and Measuring Problem Solving Performance (Concept Only) | 2 | |

| | | | | |
|---|---|---|---|---|
| | 9 | Uninformed Search Strategies: Breadth First Search, Uniform Cost Search, Depth First Search, | 4 | |
| | 10 | Informed search strategies: Greedy Best First search, A* Search, Heuristic Search (Concept Only) | 2 | |
| | 11 | Constrain Satisfaction Problems: Definition, Examples: Map colouring, Job-Shop scheduling | 2 | |
| | 12 | Constraint Propagation: Node Consistency, Arc Consistency, Path Consistency and K-Consistency | 2 | |
| **III** | **Knowledge Representation** | | **13** | **20** |
| | 13 | Logical agents: Knowledge based agents, The Wumpus world | 2 | |
| | 14 | Logic: Definition, Propositional logic, Syntax and Semantics, Simple Knowledge Base | 3 | |
| | 15 | First Order Logic: Definition, Syntax and Semantic (Models, Symbols and Interpretations, Terms, Atomic Sentences, Complex Sentences, Quantifiers, Equality) | 3 | |
| | 16 | Ontological Engineering: Definition | 1 | |
| | 17 | Categories and Objects: Physical Composition, Measurements, Objects: Things and Stuff, Process, Time Intervals, Fluent and Objects Quantifying Uncertainty (Concept Only) | 4 | |
| **IV** | **AI: Philosophical Foundations and Future** | | **9** | **12** |
| | 18 | Weak AI: Can machines act intelligently? | 1 | |
| | 19 | Strong AI: Can machines really think? | 2 | |
| | 20 | Ethics and risks of developing Artificial Intelligence | 2 | |
| | 21 | Agent components and architectures | 2 | |
| | 22 | Are we going in the right direction? What if AI succeed? | 2 | |
| **V** | **Open-Ended Module – Application Level** | | **12** | |
| | | Discuss topics from the following:<br>• Discuss on evolution of AI<br>• Analyzing different agent types and environments<br>• Building a simple Reflex Agent<br>• Identifying Problem-Solving agents in everyday applications<br>• Implementation of Tree Search<br>• Algorithmic implementation of A* Search and Heuristic Search | 10 | |

| | | | | |
|---|---|---|---|---|
| | | • Discussion on the effectiveness of heuristic methods<br>• Real-world applications of CSP<br>• Building a knowledge-based agent for the Wumpus World<br>• Discussion on uncertainty in AI | | |
| | | Case Study: Provide students with case studies or examples of AI applications in different domains (e.g., healthcare, finance, marketing). | 2 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | - | - | - | - | | | | | | |
| CO 2 | 2 | - | 2 | 2 | 2 | 2 | | | | | | |
| CO 3 | 2 | - | 2 | 2 | 2 | 2 | | | | | | |
| CO 4 | 2 | - | 2 | 2 | 2 | 2 | | | | | | |
| CO 5 | 2 | - | 2 | 2 | - | - | | | | | | |
| CO 6 | 1 | - | 1 | 1 | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | ✓ | ✓ |

**References:**


1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2010.

2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, 2017.

3. Elaine Rich, Kevin Knight, & Shivashankar B Nair, "Artificial Intelligence", McGraw Hill, 3rd Edition, 2009.


# Semester IV

## BCA4CJ205 - Database Management System

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA4CJ205 | | | | |
| Course Title | Database Management System | | | | |
| Type of Course | Major | | | | |
| Semester | IV | | | | |
| Academic Level | 200 - 299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | Discrete Mathematics, Data structures and Programming Basics | | | | |
| Course Summary | This course provides an introduction to database management systems. The topics covered include the concept of Database Management System, ER Model, Relational model, SQL, Database design, Transactions, concepts of other data model-NoSQL and practical session to implement Database Concepts. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | A comprehensive understanding of fundamental concepts in database management systems and its application | U | C | Instructor-created exams / Quiz |
| CO2 | Understand concepts of Relational Data Model | U | C | Instructor- |

| | | | | |
|---|---|---|---|---|
| | and Normalization Techniques | | | created exams / Quiz |
| CO3 | Apply principles of entity-relationship modeling and normalization techniques to design efficient and well-structured databases that meet specified requirements. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO4 | Acquire expertise in crafting and executing SQL queries for the retrieval, updating, and manipulation of data, showcasing adept skills in database querying and data manipulation | Ap | p | Practical Assignment / Observation of Practical Skills |
| CO5 | Comprehend and apply strategies for managing transactions and implementing mechanisms for controlling concurrency, ensuring the database's consistency and reliability in environments with multiple users. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO6 | Explore and analyze recent trends in database management systems, with a focus on unstructured databases, NoSQL technologies | An | P | Practical Assignment / Observation of Practical Skills |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Mark |
|---|---|---|---|---|
| **I** | **Database System- Concept** | | **10** | **15** |
| | 1 | Introduction, Characteristics of the Database Approach | 2 | |
| | 2 | Actors on the Scene, Workers behind the Scene, Advantages of Using the DBMS Approach, File system vs Database | 2 | |
| | 3 | Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence | 3 | |
| | 4 | Database Languages and Interfaces | 2 | |
| | 5 | Structured, Semi Structured and Unstructured Database | 1 | |
| **II** | **Database Design** | | **14** | **20** |
| | 6 | ER Model- Basic concepts, entity set & attributes, notations | 2 | |
| | 7 | Relationships and constraints, cardinality, participation, notations, weak entities | 2 | |
| | 8 | Relational Model Concepts-Domains, Attributes, Tuples, and Relations, Values and NULLs in the Tuple | 2 | |
| | 9 | Relational Model Constraints and Relational Database Schemas | 2 | |
| | 10 | Relational Database Design- Atomic Domain and Normalization- INF, 2NF,3NF, BCNF | 4 | |
| | 11 | 4NF,5NF | 2 | |
| **III** | **Query Languages** | | **11** | **20** |
| | 12 | SQL-, introduction to Structured Query Language (SQL) | 1 | |
| | 13 | Data Definition Language (DDL), Table definitions and operations | 2 | |
| | 14 | SQL DML (Data Manipulation Language) - SQL queries on | 4 | |

| | | | | |
|---|---|---|---|---|
| | | single and multiple tables | | |
| | 15 | Nested queries (correlated and non-correlated), Aggregation and grouping, Views, assertions, Triggers, SQL data types. | | |
| | 16 | Introduction to NoSQL Databases | 2 | |
| | 17 | Main characteristics of Key-value DB (examples from: Redis), Document DB (examples from: MongoDB) | 2 | |
| **IV** | **Transaction Processing, Concurrency Control** | | **10** | **15** |
| | 18 | Transaction Processing: Introduction, Transaction and System Concepts | 3 | |
| | 19 | Desirable Properties of Transactions | 1 | |
| | 20 | Characterizing Schedules Based on Recoverability & Serializability | 2 | |
| | 21 | Transaction Support in SQL. | 1 | |
| | 22 | Introduction to Concurrency Control: Two-Phase Locking Techniques | 3 | |
| **V** | **DBMS LAB** | | **30** | |
| | 1 | Students should decide on a case study and formulate the problem statement. | 3 | |
| | 2 | Based on Identified problem Statement, Design ER Diagram (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.) Note: Student is required to submit a document by drawing ER Diagram to the Lab teacher. | 3 | |
| | 3 | Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) Note: Student is required to submit a document showing the database tables created from ER Model. | 2 | |
| | 4 | Normalization -To remove the redundancies and anomalies in the above relational tables, Normalize up to Third Normal Form | 3 | |
| | 5 | Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables | 3 | |
| | 6 | Practicing DML commands-Insert, Select, Update, Delete | 2 | |
| | 7 | Experiment 7: Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc. | 2 | |
| | 8 | Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi). | 2 | |
| | 9 | Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping. | 4 | |
| | 10 | Install and Configure MongoDB to execute NoSQL Commands. | 6 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | - | - | - | - | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 2 | 2 | 2 | 1 | - | - | - | | | | | | |
| CO 3 | - | - | 2 | 3 | - | - | | | | | | |
| CO 4 | - | - | - | 3 | 3 | - | | | | | | |
| CO 5 | - | - | - | 3 | 3 | - | | | | | | |
| CO 6 | 2 | - | - | - | 2 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | | ✓ | ✓ | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | | ✓ | ✓ | ✓ |

**References:**

1. Database System Concepts (Sixth Edition) Avi Silberschatz, Henry F. Korth, S. Sudarshan McGraw-Hill 2011 ISBN 978-0071325226/ 0-07-352332-1.

2. Database Management Systems, Third Edition Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill ©2003 ISBN: 978-0072465631/ 0-07-246563-8.

# BCA4CJ206 - Python Programming

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA4CJ206 | | | | |
| Course Title | Python Programming | | | | |
| Type of Course | Major | | | | |
| Semester | IV | | | | |
| Academic Level | 200 - 299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | Knowledge in Fundamentals of Programming | | | | |
| Course Summary | This course explores the versatility of Python language in programming and teaches the application of various data structures using Python. The course also introduces fundamental concepts of object-oriented programming and insights into leveraging Python packages. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the basic concepts of Python programming language. | U | C | Instructor-created exams / Quiz |
| CO2 | Apply problem-solving skills using the basic constructs in Python programming | Ap | P | Coding Assignments/ Code reading and review |
| CO3 | Apply modular programming using functions in Python | Ap | P | Coding Assignments/ Code reading and review |
| CO4 | Analyse the various data structures and operations on it using Python | An | C | Instructor-created exams / Case studies |
| CO5 | Apply various packages available in Python | Ap | P | Coding Assignments/ Case studies |
| CO6 | Apply visualization tools in Python | Ap | P | Coding Assignments/ Case studies |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction to Python and Control Flow Statements** | **10** | **15** |

| | | | | |
|---|---|---|---|---|
| | 1 | Tokens in Python | 2 | |
| | 2 | Operators Precedence & Associativity & Type Conversion | 1 | |
| | 3 | Built-in functions | 1 | |
| | 4 | Decision-making Structures | 3 | |
| | 5 | Looping Structures | 3 | |
| **I** | **Introduction to Functions & Modules** | | **12** | **20** |
| **I** | 6 | Introduction to functions | 2 | |
| | 7 | Scope and lifetime of variables | 1 | |
| | 8 | Types of arguments | 3 | |
| | 9 | Types of functions – recursive, anonymous, returning more than onevalue | 3 | |
| | 10 | Introduction to Modules | 1 | |
| | 11 | User-defined modules and packages | 2 | |
| **III** | | | **12** | **20** |
| | 12 | Introduction to Strings and traversal | 2 | |
| | 13 | Slicing, splitting, and joining methods on Strings | 1 | |
| | 14 | Introduction to Lists and traversal | 1 | |
| | 15 | List methods | 2 | |
| | 16 | Introduction to Dictionaries and traversal | 1 | |
| | 17 | Dictionaries methods | 2 | |
| **IV** | **Introduction to Scientific Computing in Python** | | **11** | **15** |
| | 18 | Basics of NumPy Arrays | 2 | |
| | 19 | Computation on NumPy Arrays | 2 | |
| | 20 | Basics of Pandas objects | 3 | |
| | 21 | Basics of Matplotlib | 1 | |
| | 22 | Plotting in Matplotlib | 3 | |
| **V** | **Hands-on Data Structures: Practical Applications, Case Study and Course Project** | | **30** | |
| | 1 | **Introduction to Python**<br>• Running instructions in Interactive interpreter and a PythonScript.<br>• Generate output with print statements<br>• Read input, including casting that input to the appropriate type<br>• Perform calculations involving integers and floating point numbers using Python operators like +, -, *, /, //, %, and **<br>• Call functions residing in the math module | 20 | |
| | 2 | **If Statement**<br>• Make a decision with an if statement<br>• Select one of two alternatives with an if-else statement<br>• Select from one of several alternatives by using an if-elif or if-elif-else statement<br>Construct a complex condition for an if statement that includes theBoolean operators and, or and not | | |
| | 3 | **Loops**<br>• Iterate over a sequence using a for loop | | |

| | | | | |
|---|---|---|---|---|
| | | • Use the range () function in a form loop<br>• Create a while loop to repeat a block of code<br>• Use the break and continue statement<br>• Nested loops For loop with else clause<br>• While loop with else clause | | |
| | 4 | **Function**<br>• Define a function for later use<br>• Pass one or more values into a function<br>• Perform a complex calculation within a function<br>• Return one or more results from a function<br>• Call a function that you have defined previously | | |
| | 5 | **Strings**<br>• Create a string<br>• String Indexing<br>• Looping through a String<br>• String Slicing | | |
| | 6 | **Lists**<br>• Create a list<br>• List Indexing<br>• Looping through a list<br>• Adding items to a list<br>• Modifying items of a list<br>• Removing elements<br>• List Slicing | | |
| | 7 | **Tuples**<br>• Create a tuple<br>• Tuple Indexing<br>• Looping through a tuple<br>• Adding items to a tuple<br>• Tuple Slicing | | |
| | 8 | **Dictionary**<br>• Create a dictionary and access values with key<br>• Adding a key-value pair<br>• Adding to an empty dictionary<br>• Modifying values in a dictionary<br>• Removing key-value pair<br>• Looping through a dictionary- Looping through all key-valuepairs, Looping through all the keys, Looping through all the values | | |
| | 9 | **NumPy**<br>• Create NumPy(1 D, 2D, and 3D) arrays from a sequence<br>• Create NumPy Arrays using functions<br>• Arithmetic Computations using Universal Functions<br>• Broadcasting<br>• Fancy Logic | | |
| | 10 | **Pandas**<br>• Create a data frame from a dictionary<br>• Create an explicitly indexed series object from an array or list<br>• Create Index objects of various types | | |

| | | | | |
|---|---|---|---|---|
| | | • Perform set operations on Index objects | | |
| | 11 | **Matplotlib**<br>• Create and format a simple line plot<br>• Create and format a simple scatter plot<br>• Create and format a simple histogram<br>• Create and format a contour plot | | |
| | 12 | Case study | 3 | |
| | 13 | Capstone (/Course) Project: Build a practical application using any onepackage and implement the visualization tools | 7 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | - | - | - | - | - | | | | | | |
| CO2 | 1 | - | 2 | - | 1 | - | | | | | | |
| CO3 | 1 | - | 2 | 1 | - | - | | | | | | |
| CO4 | 1 | - | 1 | - | - | - | | | | | | |
| CO5 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | | |
| CO6 | 3 | 2 | 2 | - | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**References:**

1. Jose, Jeeva. Taming Python by Programming. Khanna Book Publishing, 2017. Print.
2. S, Gowrishankar, and A, Veena. Introduction to Python Programming. Chapman & Hall/CRC Press, 2018.
3. Downey, Allen. Think Python. Green Tea Press, 2nd ed. 2009
4. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. United States, O'Reilly Media, 2016.
5. Stephenson, Ben. The Python Workbook. SPRINGER INTERNATIONAL PU, 2016.

## BCA4CJ207 - Software Engineering

| | | | | | |
|---|---|---|---|---|---|
| Programme | Bachelor of Computer Applications (BCA) | | | | |
| Course Code | BCA4CJ207 | | | | |
| Course Title | Software Engineering | | | | |
| Type of Course | Major | | | | |
| Semester | III | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Understanding fundamental computer science concepts, data structures, and algorithms.<br>2. Basic knowledge of project planning and scheduling | | | | |
| Course Summary | After completing the course students may be engaged in practical exercises, projects, and teamwork to apply theoretical concepts to real-world scenarios. The goal is to equip students with the knowledge and skills needed to develop high-quality software solutions and contribute effectively to the software development lifecycle. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To learn and understand the Concepts of Software Engineering | Ap | C | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | To Learn and understand Software Development Life Cycle. Identify and apply appropriate SDLC models and methodologies. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |

| | | | | |
|---|---|---|---|---|
| CO3 | To apply the project management and analysis principles to software project development. | Ap | C | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | To apply principles of software design to create high-quality software architectures. Demonstrate proficiency in programming languages and coding standards. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | To apply testing techniques to ensure software quality and identify andperform different types of softwaremaintenance activities. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Prepare and deliver effective project presentations. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **THE SOFTWARE PROCESS** | | **10** | **15** |
| | 1 | Software Engineering: Nature of Software, Software Engineering, Software Process, Software Development Life Cycle | 1 | |
| | 2 | Prescriptive Process Models – Waterfall, Incremental, Evolutionary | 3 | |
| | 3 | Agile Process: What is Agility, What is agile Process? | 2 | |
| | 4 | Extreme Programming: XP Values, XP Process, Industrial XP, XP Debate | 1 | |
| | 5 | Other Agile Process Models: Adaptive Software Development, , Scrum, Dynamic Systems Development Method, Crystal | 3 | |
| **II** | **REQUIREMENT ENGINEERING** | | **10** | **15** |
| | 6 | Introduction to Requirement Engineering: Functional and non-functional requirement (Types) | 2 | |
| | 7 | Requirement engineering process | 2 | |
| | 8 | Requirement Elicitation: Concept of Requirement Elicitation, Elicitation Technique, Stories and Scenarios, | 2 | |
| | 9 | Requirement Specification: Concept, Natural Language Specification, Structured Specification, Use Cases, Software Requirement Document, | 2 | |
| | 10 | Requirement Validation: Concept, Requirement Change, | 2 | |
| **III** | **SYSTEM MODELLING, ARCHITECTURAL DESIGN** | | **14** | **20** |
| | 11 | Context models: Detailed Concept | 2 | |
| | 12 | Interaction models: Concept, Use case modelling, Sequence Diagram, | 2 | |
| | 13 | Structural Models: Concept, Class Diagram, Generalization, Aggregation, | 2 | |

| | | | | |
|---|---|---|---|---|
| | 12 | Behavioural Models: Concept, Data driven modelling, Event driven modelling, Model driven engineering, | 2 | |
| | 13 | Architectural design decisions: Detailed concept | 2 | |
| | 14 | Architectural views: Detailed concept, Layered Architecture, Repository Architecture, Client-Server architecture, Pipe and Filter Architecture. | 2 | |
| | 14 | Architectural patterns: Transaction Processing Systems, Information Systems, Language Processing System, | 2 | |
| **IV** | **TESTING, MAINTANENCE AND RE ENGINEERING** | | **14** | **20** |
| | 16 | Strategic Approach to Software Testing: Verification and Validation, Organizing for Software Testing, Software Testing Strategy | 2 | |
| | 17 | Strategies for Conventional Software: Unit and Integration Testing | 2 | |
| | 18 | Strategies for Object Oriented Software: Unit Testing and Integration Testing in OO Context. | 2 | |
| | 19 | Validation Testing, System Testing, White Box Testing and Black Box Testing | 2 | |
| | 20 | Software Maintenance - Software Supportability, Reengineering | 2 | |
| | 21 | Business Process Reengineering: Business Process, BPR Model | 2 | |
| | 22 | Software Reengineering and Reverse Engineering | 2 | |
| **V** | **Open Ended Module- Trends in Software Engineering** | | **12** | |
| | | 1. Case Study.<br>2. Engage in a substantial project that integrates knowledge from various areas of software engineering.<br>3. Explore the process of creating a software startup.<br>4. Apply critical thinking skills to software design and implementation. | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | - | - | 2 | - | | | | | | |
| CO 2 | 1 | 1 | - | - | 2 | - | | | | | | |
| CO 3 | 1 | 1 | 2 | - | 3 | - | | | | | | |
| CO 4 | 1 | 1 | 2 | - | 3 | - | | | | | | |
| CO 5 | 1 | 1 | 2 | - | 3 | 3 | | | | | | |
| CO 6 | 1 | 1 | - | - | 3 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Sommerville, I. (2016). Software Engineering (10th ed.). Pearson Education.

2. Pressman, R. S. (2010). Software Engineering: A Practitioner's Approach (7th ed.).

3. Van Vliet, H. (2008). Software Engineering: Principles and Practices.

4. Fairley, R. E. (2008). Software Engineering Concepts.

5. Khurana, R. (n.d.). Software Engineering: Principles and Practices (2nd ed.). Vikas Publishing House Pvt Ltd.

6. Jalote, P. (n.d.). An Integrated Approach to Software Engineering (3rd ed.). Narosa Publishing House.

# BCA4CJ208 - Automation and Robotics

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA4CJ208 | | | | |
| Course Title | Automation and Robotics | | | | |
| Type of Course | Major | | | | |
| Semester | IV | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | No pre-requisites required | | | | |
| Course Summary | This course provides a comprehensive overview of automation which includes their production systems, elements, automation functions and usage of discrete and continuous control system. The course also explores the fundamentals of robotics, including anatomy, process control and how these functions could be improved by the integration of Artificial Intelligence. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the production systems and automation, enabling them to analyse, optimize and evaluate the different levels of automation. | U | C | Instructor- created exams / Quiz/Assignment/ Seminar |
| CO2 | Able to recognize the difference between the process industries, manufacturing industries, continuous and discrete control system. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO3 | Proficiency in understanding the various forms of process control which includes the direct digital control, programmable logic control, distributable control systems etc. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO4 | Familiarize with the various hardware components used for automation and process control such as sensors, actuators analog-digital converters etc. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO5 | Understand the present developments in the field of automation and robotics and how integrating artificial intelligence can contribute to the future of these systems. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |

| | | | | |
|---|---|---|---|---|
| CO6 | Represent various problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools. | U, Ap | C, P | Practical Assignment / Observation of Practical Skills |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Contents | Hrs (48+12) | Mark |
|---|---|---|---|---|
| I | | **Introduction to Automation** | **11** | **15** |
| | 1 | Production systems - Facilities, Manufacturing support systems | 2 | |
| | 2 | Automation in production systems – Automated manufacturing system, Computerized manufacturing support systems, Reasons for automating | 3 | |
| | 3 | Manual labour in production systems | 1 | |
| | 4 | Elements of automation - power to accomplish the process, Program of instructions, control system | 3 | |
| | 5 | Advanced automation functions – safety monitoring, maintenance and repair diagnostics, error detection and recovery | 1 | |
| | 6 | Levels of automation | 1 | |
| II | | **Control Systems** | **14** | **15** |
| | 7 | Process industries versus Discrete manufacturing industries, Continuous versus Discrete control | 2 | |
| | 8 | Continuous control system | 3 | |
| | 9 | Discrete control system | 1 | |
| | 10 | Computer process control, Control requirements, Capabilities of computer control | 2 | |
| | 11 | Forms of computer process control - Computer process monitoring, Direct digital control, Computer numerical control and robotics, Programmable logic controllers, Supervisory control and data acquisition, Distributed control systems | 3 | |
| | 12 | Hardware for automation and process control (Concept only) - Sensors, Actuators, Analog to Digital converters Digital to Analog converters, Input/output devices for discrete data. | 3 | |
| **III** | | **Industrial Robotics** | **15** | **25** |

| | | | | |
|---|---|---|---|---|
| | 13 | Robot anatomy – Joints and links, Common robot configurations, Joint drive systems, Sensors in robotics | 4 | |
| | 14 | Robot control systems – Limited sequence control, Playback with point-to-point control, Playback with continuous path control, Intelligent control | 2 | |
| | 15 | End effectors – Grippers, Tools | 1 | |
| | 16 | Robot Programming – Lead through programming, Powered lead through, Motion programming, Advantages and disadvantages | 2 | |
| | 17 | Discrete process control – logic control, sequence control | 4 | |
| | 18 | Programmable Logic Controllers, Components of PLC | 2 | |
| **IV** | **Automation and Robotics: Present and Future** | | **8** | **15** |
| | 19 | Machine Intelligence, Computer and Robotics | 2 | |
| | 20 | Flexible automation vs Robotics technology | 2 | |
| | 21 | Artificial Intelligence and Automated Manufacturing, AI and Robotics | 2 | |
| | 22 | Robotics in India, Future of Robotics | 2 | |
| **V** | **Open Ended Module – Application Level** | | **12** | |
| | 1 | Discuss topics from the following:<br>• Role of manual labour in modern manufacturing.<br>• Benefits and challenges of automation.<br>• Developing a simple automated process with control instructions.<br>• Types of error detection and recovery system.<br>• Discussion on the impact of automation levels on production efficiency.<br>• Exploring the role of computer process control in modern manufacturing<br>• Implementing basic computer process control using simulation software.<br>• Visioning the future of robotics in India. | 10 | |
| | 2 | Host a discussion session on the intersection of Artificial Intelligence (AI) and Robotics in automated manufacturing. | 2 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | - | - | - | - | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 2 | 2 | 2 | - | - | 2 | - | | | | | | |
| CO 3 | 2 | 2 | - | - | 2 | - | | | | | | |
| CO 4 | 2 | 2 | - | - | 2 | - | | | | | | |
| CO 5 | 1 | - | - | - | - | 1 | | | | | | |
| CO 6 | - | - | 2 | 2 | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | ✓ | ✓ |

**References:**

1. Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 4th edition, Pearson Education, 2017.

2. S.R. Deb, S. Deb “ Robotics Technology and flexible automation,” Tata McGraw-Hill Education, 2017.

3. Mikell P. Groover, “ "Industrial Robots - Technology, Programming and Applications", McGraw-Hill Education, 2017.

# Semester V

## BCA5CJ301 - Object Oriented Programming (Java)

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5CJ301 | | | | |
| Course Title | Object Oriented Programming (Java) | | | | |
| Type of Course | Major | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Knowledge in basic programming<br>2. Knowledge in OOP Concepts | | | | |
| Course Summary | The aim of this course is to provide students with an understanding of the basic concepts in Java programming. This course will help students create GUI applications in Java and establish database connectivity. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To understand the concepts and features of Object-Oriented Programming (OOPs) | U | C | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | To practice programming in Java | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | To learn java's exception handling mechanism, I/O operations and multithreading. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | To learn java's O operations and multithreading. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Implement programs using Java Database Connectivity | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Students will be capable of | Ap | P | Practical |

| | | | | |
|---|---|---|---|---|
| | developing Graphical User Interface (GUI) applications using Swing, understanding layout management, and implementing basic event handling. | | | Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Review of OOPs and Introduction to Java** | | **17** | **20** |
| | 1 | Overview of OOPs Concept | 1 | |
| | 2 | History of Java and Java Virtual Machine | 1 | |
| | 3 | Basic Structure of Java Programming: Data Types, Operators, Expression and Control Statement | 2 | |
| | 5 | Arrays and String: One Dimensional Array, Multidimensional Array, String Operations | 2 | |
| | 6 | Scanner, Type Conversion and Casting | 2 | |
| | 7 | Introduction to Class and Objects: Definition of Class and Objects, Access Modifier | 2 | |
| | 8 | Constructor and Inheritance: Types of Constructors, Types of Inheritance, use of extends, super, final, this keyword | 3 | |
| | 9 | Method Overriding, Method Overloading and Dynamic Method Dispatch: Programming implementation of Method Overriding and Overloading | 2 | |
| | 10 | Interface, Abstract Class and Packages; Programming implementation of Interface, Abstract class and Packages | 2 | |
| **II** | **Exception and I/O Operations** | | **8** | **15** |
| | 11 | Exception: Baic Concept of exception and Exception Hierarchy | 2 | |
| | 12 | Managing Exception: Use of try….catch ….. finally blocks, throw and throws keyword | 2 | |
| | 13 | Managing Input/Output files in Java: Importance of I/O Operations, BufferedInputStream, BufferedOutputStream | 2 | |
| | 14 | File Operations: Programming implementation of FileInputStream, FileOutputStream, FileReader, FileWriter | 2 | |
| **III** | **Multithreading and Database Connectivity** | | **9** | **20** |
| | 15 | Thread: Concept of Thread and Thread state | 2 | |

| | | | | |
|---|---|---|---|---|
| | 16 | Programming Implementation of Thread: Using extending thread class and Runnable interface, Thread Priorities | 2 | |
| | 17 | Database Programming: Basic Concept of Database and JDBC Driver, Connecting with Database | 2 | |
| | 18 | Querying Database: Programming implementation of creating table, insert and update values to the table using preparedStatement, Statement object and querying the values using ResultSet and ResultSetMetadata | 3 | |
| **IV** | **GUI Programming** | | **11** | **15** |
| | 19 | Introduction to GUI Application: AWT Basics, Introduction to IDE | 2 | |
| | 20 | Swing Programming: Introduction of Model-View-Controller Pattern | 2 | |
| | 21 | Introduction to layout Management: Fundamental controls used in SWING | 4 | |
| | 22 | Event Handling: Basic Knowledge of Event Handling (Event Class and Event Listener) | 3 | |
| **V** | **Hands-on Programming in Java(Using IDE NetBeans, Eclipse, VSCode):** | | **30** | **30** |
| | **Practical Applications, Case Study and Course Project** | | | |
| | 1 | Implement the following: | | |
| | | **1. String and Arrays:** | 20 | |
| | | Write a program to perform various String operations in Java (Hint: charAt, substring, concat, equals,, isEmpty..) | | |
| | | Write a program to implement Multi-Dimensional Array (Hint : Matrix multiplication) | | |
| | | **2. Object Oriented Programming Concept:** | | |
| | | Write a program to implement the concept of class and object (Hint: Complex Number addition) | | |
| | | Write a program to demonstrate the order in which constructors are invoked in multilevel inheritance. | | |
| | | Write a program to implement method overloading | | |
| | | Write a program to implement method overriding. | | |
| | | **3. Exception Handling and Multithreading:** | | |
| | | Write a program to implement try…cath, finally block (Hint: Arithmetic and ArrayOutOfBoundException) | | |
| | | Write a multi thread java program for displaying odd numbers and even numbers up to a limit (Hint: Create thread by inheriting Thread class). | | |
| | | Write a multi thread java program for displaying odd numbers and even numbers up to a limit (Hint: Implement thread using Runnable interface). | | |
| | | **4. GUI Application with Database:** | | |

| | | | | |
|---|---|---|---|---|
| | | Write a swing program to track mouse & key events | | |
| | | Write a swing program to fetch data from TextFiled and display it in Label | | |
| | | Write a swing program to perform form validation | | |
| | | Write a swing program to display data in tabular form | | |
| | | Write a simple login program without database connectivity | | |
| | | Write a swing program to create a registration form (Hint: Create table student in any database and link the registration form with database using JDBC) | | |
| | 2 | Case Study | 2 | |
| | 3 | **Project:** Build a application for shop management system (Eg: Admin Login, Product registration, stock management, product selling, employee salary) | 8 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 3 | 3 | - | - | | | | | | |
| CO 2 | 1 | - | 3 | 3 | - | - | | | | | | |
| CO 3 | - | - | 3 | 3 | 2 | 3 | | | | | | |
| CO 4 | - | - | 2 | 3 | - | - | | | | | | |
| CO 5 | - | - | 3 | 3 | 2 | 3 | | | | | | |
| CO 6 | | | 3 | 3 | 3 | | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |

**References:**


1. Herbert Scheldt, Java: The Complete Reference, 12th Edition, Tata McGraw-Hill Edition, ISBN: 9781260463415.

2. C. Thomas Wu, An introduction to Object-oriented programming with Java, 5e, McGraw-Hill, 2009.
3. Y. Daniel Liang, Introduction to Java programming, Comprehensive Version, 10e, Prentice Hall India, 2013.
4. K. Arnold, J. Gosling, David Holmes, The JAVA programming language, 4e, Addision-Wesley, 2005.


## BCA5CJ302 - Progressive Web Application using PHP

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5CJ302 | | | | |
| Course Title | Progressive Web Application using PHP | | | | |
| Type of Course | Major | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Knowledge in basic programming<br>2. Basic Knowledge in HTML | | | | |
| Course Summary | main objective of this course is to develop dynamic web pages. To implement server-side scripting and client-side scripting, data base connectivity to develop dynamic web page. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| CO1 | To familiar with the concept HTML5 | U | P | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | To familiar with the concept CSS, Javascript, Server-Side Scripting | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | To learn the PHP programming environment | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | To learn how to develop a dynamic website using PHP and PostgreSQL | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Students will acquire knowledge of common security vulnerabilities in web applications and understand best practices for writingsecure PHP code. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Students will be equipped to develop modular and scalable PHP applications using object-oriented techniques. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Web Document** | | **16** | **22** |
| | 1 | Introduction to the Web Programming | 1 | |
| | 2 | Client and Server-Side Scripting | 1 | |
| | 3 | Introduction to HTML 5: Essential of HTML 5, Exploring New Features, Structuring an HTML document | 2 | |
| | 5 | Fundamentals of HTML: Elements and Attributes, Data Types, HTML form elements, Organizing the text in HTML | 2 | |
| | 6 | Advance features of HTML: Working with links and URLs, Creating the table, Creating with images, colors and Canvas | 2 | |
| | 7 | HTML5 Web Workers: HTML5 Web Storage, HTML5 Cache Manifes, Basics Web Worker | 2 | |
| | 8 | Fundamentals of CSS: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in HTML | 2 | |

| | | | | |
|---|---|---|---|---|
| | 9 | CSS Effects: Background and Color Gradient in CSS,Fonts and Text styles in CSS, Creating Boxes and Columnsusing CSS | 2 | |
| | 10 | Working with CSS: Working with Class, CSS ID, List and Tables, CSS3 basic transformation | 2 | |
| **II** | **Exploring Scripting Language** | | **8** | **13** |
| | 11 | Introduction to JavaScript: Overview of JavaScript, Programming Fundamentals of JavaScript (Variable, operators, Control Flow, Conditional Statement) | 2 | |
| | 12 | Functions of JavaScript: Working with Functions(Invoking function, Return statement, Function withparameter, Built in Function), JavasCript Objects (String, RegExp, Boolean, Number, Array, Math, Date) | 2 | |
| | 13 | Events Familiarization: onLoad, onClick, onBlur, onSubmit, onChange, Document Object, Model (Concept). Objects: String, Array, Date | 2 | |
| | 14 | Introduction to JQuery: Fundamentals of JQuery, JQuery Selectors, Basic JQuery methods, Jquery events, Jquery Effects | 2 | |
| **III** | **Introduction to PHP** | | **10** | **20** |
| | 15 | Fundamentals of PHP: History of PHP, General structure of PHP, Displaying Output, Escaping Special Characters, Comments, | 3 | |
| | 16 | Variables – (Declaring, Assigning, Destroying), Datatypes, Setting and Testing Datatypes – Constants -Operators (Arithmetic, Comparison, Logical, Assignment, Concatenation) – Super global variables | 2 | |
| | 17 | Basics of PHP: Control structures – Looping structures - 1-D Array & its manipulation (Storing Data, Assigning, Accessing Array Elements, Displaying) - User-Defined Functions, Function Scope | 2 | |
| | 18 | Advanced PHP and Form Interaction: Working with PHP: Passing information between pages, HTTP GET and POST method, Cookie, Session. String functions: strlen, strops, strstr, strcmp, substr, str_replace, string case, Array constructs: array(), list() and foreach(). Header(). | 3 | |
| **IV** | **Database programming and PHP** | | **11** | **15** |
| | 19 | Overview of MySQL: Features of MySQL, data types, basic queries (CREATE, INSERT, SELECT, UPDATE, DELETE) | 2 | |
| | 20 | PHP functions for MySQL operations: mysqLconnect, mysql_select_db, mysqLquery, mysql_fetch_row, mysql_fetch_array, mysql_fetch_object, mysqLresult, Insertion and Deletion of data using PHP, Displaying data from MySQL database in webpage. | 4 | |
| | 21 | Introduction to AJAX - Implementation of AJAX in PHP - Simple example for partial page update. | 2 | |
| | 22 | Introduction to Laravel's: Fundamental concept, Features, MVC Architecture, Installing Laravel, Building | 3 | |

| | | | | |
|---|---|---|---|---|
| | | Application with Laravel | | |
| **V** | **Hands-on Programming in PHP (Using IDE NetBeans, Notepad++, VSCode):** | | **30** | |
| | **Practical Applications, Case Study and Course Project** | | | |
| | 1 | Implement the following: | | |
| | | **1. HTML and CSS** | 20 | |
| | | Design a webpage that illustrates the use of the following form controls:<br>(i) Input controls: single-line text, password, radio-button, multi-line text.<br>(ii) Buttons: submit and reset | | |
| | | Design a webpage that illustrates the use of the following form controls:<br>(i) Input controls: data list, multi-select box, grouped select box<br>(ii) Buttons: submit and reset | | |
| | | Design a webpage that illustrates the use of field sets and legends | | |
| | | Design a web page to demonstrate Text alignment and Border colours using internal CSS | | |
| | | Using HTML, CSS create a custom hover and focus effect for navigation items, using CSS transformations | | |
| | | Design a web page to demonstrate inline CSS. | | |
| | | **2. JavaScript and JQuery** | | |
| | | Write a JavaScript program to calculate multiplication and division of two numbers (input from the user). | | |
| | | Write a JavaScript program to convert a number in bytes to a human-readable string. | | |
| | | Write a JavaScript program that implements a "form" validation that displays an error message if a required field is left empty when submitting the form. | | |
| | | Write a JavaScript program to compare two objects to determine if the first contains equivalent property values to the second one. | | |
| | | **3. Database Programming** | | |
| | | Create a php program to display the bio data of a person by reading the personal details using an HTML page. | | |
| | | Create a login page using database. | | |
| | | Create a MySQL table student with fields roll no, name, mark, grade. Write a PHP program to insert and display the mark list of a student by accepting the register no of the student. | | |
| | | Design a PHP page to implement a login screen using sessions. Login details are to be verified from the server side with values stored in a database. | | |
| | | Design a PHP page to illustrate the use of file upload – uploading files of a type with a specified size to the webserver | | |

| | | | | |
|---|---|---|---|---|
| | | Design sample application using Leravel | | |
| | 2 | Case Study | 2 | |
| | 3 | **Project:** Build a web application for shop management system (Eg: Admin Login, Product registration, stock management, product selling, employee salary) | 8 | |

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO4 | PSO 5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 3 | 3 | - | - | | | | | | |
| CO 2 | 1 | - | 3 | 3 | - | - | | | | | | |
| CO 3 | - | - | 3 | 3 | 2 | 3 | | | | | | |
| CO 4 | - | - | 2 | 3 | - | - | | | | | | |
| CO 5 | - | - | 3 | 3 | 2 | 3 | | | | | | |
| CO 6 | | | 3 | 3 | 3 | | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |

**References:**

1. Dreamtech Press. (2016). HTML 5 Blackbook. ISBN 9879351199076.

2. Gilmore, W. (n.d.). Beginning PHP and PostgreSQL 8: From Novice to Professional. Goels Computer Hut. ISBN: 9788181286000.

3. Duckett, J. (n.d.). Beginning Web Programming with HTML, XHTML, CSS. Wrox.

4. Converse, J., & Park, J. (n.d.). PHP & MySQL Bible. Wiley.

5. PostgreSQL. (n.d.). Official Documentation Online.

## BCA5CJ303 - Digital Fundamentals and Computer Organization

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5CJ303 | | | | |
| Course Title | Digital Fundamentals and Computer Organization | | | | |
| Type of Course | Major | | | | |
| Semester | V | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic understanding of mathematical concepts, especially areas like algebra | | | | |
| Course Summary | This course provides a comprehensive introduction to the fundamentals of digital systems, covering topics related to binary arithmetic, basic computer logic, combinational and sequential logic circuits, as well as basic computer organization and design. Throughout the course, students will gain a solid understanding of digital systems, from the basic building blocks of logic circuits to the design and organization of processors and memory | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand Basic Binary Arithmetic Techniques | U | C | Instructor-created exams / Quiz |
| CO2 | Implement logic operations using basic gates and Boolean algebra, design and optimise logic expressions using | Ap | P | Instructor-created exams/ Home |

| | | | | |
|---|---|---|---|---|
| | Karnaugh maps and design combinational logic circuits | | | Assignments |
| CO3 | Understand the operation of latches and flipflops and the design of sequential logic circuits | U | C | Instructor-created exams |
| CO4 | Learn the basic computer organization by understanding the role of registers, buses, ALU and control unit and the concepts like parallel processing and pipelining | U | C | Instructor-created exams |
| CO5 | Understand how instructions represented, addressed and executed and how a microprogrammed control unit work | U | C | Instructor-created exams |
| CO6 | Understand the concepts of memory and IO organization | U | C | Instructor-created exams |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | | **Number systems and Boolean Algebra** | **10** | **15** |
| | 1 | Binary arithmetic: Addition, Subtraction, Concepts of 1's and 2's complement, 1's and 2's complement addition | 2 | |
| | 2 | Logic Gates: AND, OR, NOT, NOR, NAND, XOR, XNOR, Universal Property of NAND and NOR gates | 3 | |
| | 3 | Boolean algebra: Boolean operations, laws and rules, Demorgan's theorem | 2 | |
| | 4 | Boolean Expression Simplification using K Map up to 4 variables | 3 | |
| **II** | | **Combinational and Sequential Logic Circuits** | **12** | **20** |
| | 5 | Combinational Circuits: Half Adder, Full Adder, Ripple Carry Adder | 1 | |
| | 6 | Combinational Circuits: Encoder and Decoder (Basic Circuit Only) | 1 | |
| | 7 | Combinational Circuits: Multiplexer and Demultiplexer (Basic Circuit Only) | 1 | |
| | 8 | Concepts of Latches and Flipflops, Types of Flipflops (SR, D, JK, T): Truth Table and Circuit | 3 | |
| | 9 | Sequential Circuits: Synchronous and Asynchronous Counters | 4 | |
| | 10 | Johnsons and Ring counter, Shift Registers | 2 | |
| **III** | | **Basic Computer Organization and Micro Programmed Control** | **10** | **15** |
| | 11 | Instruction codes, Registers and Common Bus system | 2 | |
| | 12 | Computer Instructions | 1 | |
| | 13 | Timing and Control: Concepts of hardwired and microprogrammed control | 1 | |
| | 14 | Instruction Cycle | 1 | |
| | 15 | Microprogrammed Control: Control memory & Address Sequencing | 3 | |
| | 16 | Micro Instruction Format and Symbolic Micro Instruction | 2 | |
| **IV** | | **Processor, Memory and I/O Organization** | **16** | **20** |

| | | | | |
|---|---|---|---|---|
| | 17 | Processor Organisation: General Register organization and stack organization, Instruction formats and addressing modes | 4 | **15** |
| | 18 | Processor Organisation: RISC vs CISC, Parallel Processing | 2 | |
| | 19 | Pipelining: General Considerations, Arithmetic Pipeline, Instruction Pipeline | 3 | |
| | 20 | Memory Organisation: Memory Hierarchy, Main Memory | 1 | |
| | 21 | Associative Memory, Cache Memory Mapping | 4 | |
| | 22 | IO Organisation: Modes of transfer: programmed IO, Interrupt initiated IO, DMA (Concepts Only) | 2 | |
| **V** | **Open Ended Module: Computer Arithmetic & Types of Instruction** | | **12** | |
| | 1 | Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms | 7 | |
| | 2 | Examples for Memory Reference, Register Reference, Input Output Instructions, Data Transfer Instructions, Data Manipulation Instructions, Arithmetic Instructions, Logical and Bit Manipulation Instructions, Shift Instructions, Program Control Instruction, Conditional Branch Instructions<br>Subroutine Call and Return | 5 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | - | - | - | - | - | | | | | | |
| CO 2 | - | 3 | - | - | - | - | | | | | | |
| CO 3 | - | 3 | - | - | - | - | | | | | | |
| CO 4 | - | 2 | - | - | - | - | | | | | | |
| CO 5 | - | 3 | - | - | - | - | | | | | | |
| CO 6 | - | 3 | - | - | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | | | ✓ |

**References:**


1. "Digital Fundamentals", Thomas L. Floyd
2. "Computer System Architecture", M. Morris Mano
3. "Computer Organization", Carl Hamacher, Zvonko Vranesic


# Semester VI

## BCA6CJ304/BCA8MN304 - Introduction to AI and ML

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6CJ304/BCA8MN304 | | | | |
| Course Title | Introduction to AI and ML | | | | |
| Type of Course | Major | | | | |
| Semester | VI | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Fundamental Mathematics Concepts: Sets<br>2. Fundamentals of Python Programming | | | | |
| Course Summary | This course provides an introduction to the ideas, techniques, and applications of artificial intelligence (AI) is given in this course. The fundamentals of knowledge representation, machine learning, and problem solving will be taught to the students. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Differentiate various knowledge representation methods, AI operations, Machine learning approaches and real-world applications. | U | C | Instructor-created exams / Quiz |
| CO2 | Master Problem-Solving Techniques (search algorithms, heuristic approaches, and informed search strategies). Analyse and evaluate its efficiency. | U | P | Practical Assignment / Observation of Practical Skills |
| CO3 | Investigate the properties and applications of various machine learning techniques | Ap | P | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Evaluate Artificial Intelligence Search algorithms and Machine learning approaches' efficiency. | U | C | Instructor-created exams / Home Assignments |
| CO5 | Implement and analyse Machine learning algorithms to solve practical problems. | Ap | P | One Minute Reflection Writing assignments |
| CO6 | Apply Concepts in Real-World Projects | Ap | P | Case Study/ mini Project |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Artificial Intelligence & Problem Solving and Searching** | | **15** | **15** |
| | 1 | Introduction to AI – AI problems, AI Techniques | 2 | |
| | 2 | Various AI Domains (Introduction only) | 1 | |
| | 3 | Problem Solving Techniques - Search Algorithms, Knowledge representation and reasoning, constraint satisfaction problems, Game playing, Machine learning, Simulated Annealing (Concepts only) | 3 | |
| | 4 | Uninformed search algorithms (breadth-first, depth-first) | 3 | |
| | 5 | Informed search algorithms (A*, heuristic search- Generate and Test, Hill Climbing, Best First Search) | 6 | |
| **II** | **Knowledge Representation & Reasoning** | | **10** | **20** |
| | 6 | Knowledge representation using Propositional & Predicate Logic | 3 | |
| | 7 | Semantic Networks & Frames | 3 | |
| | 8 | Rule based system & Introduction to Expert System (Concepts only) | 2 | |

| | | | | |
|---|---|---|---|---|
| | 9 | Reasoning- Forward Vs Backward reasoning & logics for non-monotonic Reasoning | 2 | |
| **III** | **Introduction to Neural Networks** | | **8** | **15** |
| | 10 | Introduction to Artificial Neural Network | 1 | |
| | 11 | Understanding Brain & Perceptron Model | 1 | |
| | 12 | Single Layer Perceptron Model & Learning in Single layer Perceptron Model | 2 | |
| | 13 | Multi-Layer Perceptron Model & Learning in Multi-layer Perceptron Model | 2 | |
| | 14 | Introduction to python packages- keras & sklearn | 2 | |
| **IV** | | **Machine Learning Fundamentals** | **12** | **20** |
| | 15 | Introduction to Machine learning- Applications of Machine Learning | 1 | |
| | 16 | Supervised Machine learning- Classification & regression algorithms (Introduction: Linear Regression, Decision tree) | 2 | |
| | 17 | Unsupervised Machine Learning-Clustering & Dimensionality Reduction (Introduction: K means Clustering, PCA) | 2 | |
| | 18 | Reinforcement Learning: Elements of Reinforcement Learning | 2 | |
| | 19 | Feature Engineering & Feature Selection | 2 | |
| | 20 | Building a classification model by training with data | 1 | |
| | 21 | Classification model evaluation- Introduction to confusion matrix | 1 | |
| | 22 | Practical implementation to set up a machine learning model | 1 | |
| **V** | **Hands-on Artificial Intelligence & Machine Learning using Python: Practical Applications, Case Study and Course Project** | | **30** | |
| | 1 | Implement the following:<br>**1. Search algorithms**<br>BFS<br>DFS<br>**2. Neural Network**<br>Building a single layer perceptron using Keras<br>**3. Multi-layer Neural Network**<br>Setting up a multi-layer perceptron model<br>**4. Supervised machine learning**<br>Linear regression<br>Decision tree<br>**5. Unsupervised machine learning**<br>K means clustering<br>PCA<br>**6. Feature Engineering**<br>Feature selection from a dataset | 20 | |
| | 2 | Case study – AI tools / Use of AI in any movie | 3 | |
| | 3 | Implementation of Comparison of any two machine learning algorithms on a dataset | 7 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | 1 | 1 | 1 | 2 | 1 | | | | | | |
| CO 2 | 1 | 3 | 2 | 3 | 2 | 2 | | | | | | |
| CO 3 | 2 | 3 | 2 | 3 | 2 | 3 | | | | | | |
| CO 4 | 2 | - | 1 | 2 | - | - | | | | | | |
| CO 5 | 2 | - | 2 | 3 | 3 | 3 | | | | | | |
| CO 6 | 3 | - | - | 3 | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | ✓ | ✓ |
| CO 6 | | ✓ | ✓ | |

**References:**

1. Elaine Rich, Kevin Knight, Shivsankar B Nair, "Artificial Intelligence", Third Edition, Tata McGraw Hill Publisher

2. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1st Ed.

3. Ethem Alpaydin, Introduction to Machine Learning- 3rd Edition, PHI.

## BCA6CJ305/BCA8MN305 - Principles of Operating System

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6CJ305/BCA8MN305 | | | | |
| Course Title | Principles of Operating System | | | | |
| Type of Course | Major | | | | |
| Semester | VI | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | Knowledge in Basic System Architecture | | | | |
| Course Summary | This course provides students with a comprehensive understanding of the fundamental principles, design concepts, and practical implementation aspects of operating systems. The course covers key topics such as Process Management, CPU Scheduling, Memory Management and Linux Shell Programming concepts. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Summarize the History, Objectives and Functions of an operating system | U | C | Instructor-created exams / Quiz |
| CO2 | Understand process management concepts: Process Control Block, States, Scheduling, Operations, Inter process Communication | U | C | Instructor-created exams |
| CO3 | Evaluate various processor scheduling strategies, algorithms | E | P | Seminar Presentation / Group Tutorial Work |
| CO4 | Apply process synchronisation concepts for effective process management | Ap | P | Viva Voce |
| CO5 | Analyse conditions for deadlock occurrence and methods of resolving. | An | C | Instructor-created exams/Assignments |
| CO6 | Describe various memory management techniques, including paging , segmentation and virtual memory | U | C | Instructor-created exams / Home Assignments |

| | | | | |
|---|---|---|---|---|
| CO7 | Develop Shell Scripts using Linux | C | P | Practical Assignment / Observation of Practical Skills |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Operating Systems & Process Management** | | **10** | **15** |
| | 1 | Operating System: History, Types, Objectives and Functions | 2 | |
| | 2 | Process Concepts: Process States, Process Control Block | 2 | |
| | 3 | Types of Process Schedulers and Operations on Process | 2 | |
| | 4 | Cooperating Processes | 2 | |
| | 5 | Inter Process Communication | 2 | |
| **II** | **CPU Scheduling, Process Synchronisation and Deadlocks** | | **15** | **20** |
| | 6 | Basic Scheduling Concepts, Scheduling Criteria | 1 | |
| | 7 | CPU Scheduling Algorithms | 2 | |
| | 8 | Process Synchronisation: Critical Section | 2 | |
| | 9 | Semaphores | 2 | |
| | 10 | Classical Problems of Synchronisation: Reader Writer, Dining Philosopher | 2 | |
| | 11 | Introduction to Deadlock: Necessary Conditions, Resource Allocation Graph | 2 | |
| | 12 | Handling Deadlocks: Prevention, Avoidance, Detection & Recovery | 4 | |
| **III** | **Memory Management Techniques** | | **10** | **20** |
| | 13 | Basic Concepts: Physical VS Logical Address, Continuous Memory Allocation | 2 | |
| | 14 | Fragmentation Problem and Solutions | 1 | |
| | 15 | Non contiguous Memory Allocation: Paging | 2 | |
| | 16 | Non contiguous Memory Allocation: Segmentation, Segmentation with Paging | 2 | |
| | 17 | Virtual Memory Concepts: Demand Paging and Page Replacement Algorithms, Thrashing | 3 | |
| **IV** | **Linux Shell Programming** | | **10** | **15** |
| | 18 | Introduction: Types of Linux Shells, File<br>Directory & File Management Commands: ls, cd, pwd, mkdir, rm, cp, mv, chmod, touch<br>Input/Output Commands: read, echo,<br>Text Processing Commands: grep, cat | 2 | |
| | 19 | Piping and Redirection operators: \|, >, <, >>, <<<br>Arithmetic, Logical and Relational Operator | 2 | |
| | 20 | Iterative and Conditional Commands: if, while, for, break, continue, case | 2 | |
| | 21 | Arrays and functions | 2 | |
| | 22 | Command line arguments, Network commands: ipconfig, ping, date and time commands, Informative commands: random, w, ps, free, | 2 | |

| | | | | |
|---|---|---|---|---|
| | | uptime | | |
| **V** | **Practical Applications using Linux Shell Programming** | | **30** | |
| | | Implement the following:<br>1. Write a Shell Script to find the roots of a quadratic equation.<br>2. Write a shell script for a menu driven program to perform file management (File creation, display content, remove, write content to a file).<br>3. Write a shell script to count no of line, words and characters of an input file.<br>4. Write a shell script to find the average of the number entered as command line arguments.<br>5. Write a shell script to copy the contents of file to another. Input file names through command line. The copy should not be allowed if second file exists.<br>6. Write a shell script to check network connectivity.<br>7. Write a shell script that analyzes a log file, extracting and summarizing relevant information such as error counts ,warning messages, info and debug messages using grep command.<br>8. Write a shell script to display current date and time, list all user account names, count of logged in user accounts, list all logged in user accounts with login time.<br>9. Write a simple game script using random function to implement number guessing game.<br>10. Write a shell script to display your system details (number of users, current processes, memory usage, system running time).<br>11. Write a shell script to implement and examine the effectiveness of the First Come First Serve \CPU Scheduling algorithm. Find the average waiting time and turnaround time.<br>12. Write a shell script program to implement Inter Process Communication. | 30 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | 1 | - | - | - | - | | | | | | |
| CO 2 | - | 2 | - | - | - | - | | | | | | |
| CO 3 | - | 3 | - | 1 | - | - | | | | | | |
| CO 4 | - | 2 | 2 | - | - | - | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 5 | - | 3 | - | - | - | - | | | | | | |
| CO 6 | - | 3 | - | - | - | - | | | | | | |
| CO7 | - | - | 2 | 2 | - | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | ✓ | | | ✓ |
| CO 6 | ✓ | | | ✓ |
| CO7 | | | ✓ | |

**References:**

1. Silberschatz, Galvin and Gagne, Operating System Concepts, John Willey & Sons
2. William Stallings, Operating Systems, Internals and Design Principles, PHI

# Semester VII

## BCA7CJ401 - Advanced Data Structures and Algorithms

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7CJ401 | | | | |
| Course Title | Advanced Data Structures and algorithms | | | | |
| Type of Course | Major | | | | |
| Semester | VII | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Fundamental Mathematics Concepts: Sets, matrices<br>2. Awareness of Data structures and operations like array, stack, queue<br>3. Fundamentals of Java, C Programming | | | | |
| Course Summary | This course provides an introduction to the ideas, techniques, and applications of advanced data structures) is given in this course. The advanced data structures and its variants like tree, graph, heaps are covered in this syllabus. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the concepts of advanced data structures like tree, graphs, heaps. | U | C | Instructor-created exams / Quiz |
| CO2 | Understand familiarity with algorithmic techniques such as brute force, greedy, and divide and conquer. | U | C | Practical Assignment / Observation of Practical Skills |
| CO3 | Understand Asymptotic analysis (big-O notation, time and space complexity). | U | F | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Application of advanced abstract data type (ADT) and data structures insolving real world problems. | AP | P | Instructor-created exams / Home Assignments |
| CO5 | Effectively combine fundamental data structures and algorithmic techniques in building a complete algorithmic solution to a given problem | Ap | P | Writing assignments/ Instructor-created exams/ practicals |
| CO6 | Apply Concepts of data structures in real world problem solving | Ap | P | Case Study/ mini Project/ practicals |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Data Structures and Analysis of Quality of an Algorithm** | | **9** | **12** |
| | 1 | Data structure - definition - types & operations, characteristics of data structures | 2 | |
| | 2 | Abstract Data Type (ADT) – algorithms - concepts - definition - objectives of algorithms - | 1 | |
| | 3 | Quality of an algorithm - space complexity and time complexity of an algorithm. | 2 | |
| | 4 | Growth of Functions: Asymptotic notations, Cost estimation based on key operations- Big Oh, Big Omega, Little Oh, Little Omega and Theta notations | 3 | |
| | 5 | Algorithm Design: Introduction, Steps in developing algorithm, Methods of specifying an algorithm | 1 | |
| **II** | **Basic Technique for Design of Efficient Algorithm** | | **11** | **15** |
| | 6 | Brute Force approach (String pattern matching) | 1 | |
| | 7 | Divide-and-Conquer approach (Merge sort) | 1 | |
| | 8 | Branch-and-Bound technique (Knapsack problem) | 2 | |
| | 9 | Greedy approach (Kruskal's algorithm and Prim's Algorithm) | 3 | |
| | 10 | Dynamic Programming (Longest Common Subsequence) | 2 | |
| | 11 | Backtracking (Sum of subsets problem) | 2 | |
| **III** | **Linked lists - operations and implementations** | | **12** | **15** |
| | 12 | Introduction to Singly Linked list and its operations | 2 | |
| | 13 | Circular Linked list and its operations | 3 | |
| | 14 | Doubly Linked list and its operations | 2 | |
| | 15 | Circular Doubly Linked list and its operations | 2 | |
| | 16 | Recursive lists, heterogeneous lists, deterministic skip lists- Creation & Searching | 3 | |
| **IV** | | **Non-linear Data Structures** | **13** | **20** |
| | 17 | Binary search trees - traversals and operations on BST | 3 | |
| | 18 | AVL tree, Red Black Tree (concept only) | 2 | |
| | 19 | Balanced trees - M-way trees - B Tree (Concepts only) | 1 | |
| | 20 | Graphs - representation of graphs | 1 | |
| | 21 | Graphs- operations - traversals and their implementation. | 2 | |
| | 22 | Heap structures- Min-Max heaps - Deaps - leftist heaps - binomial heaps (concepts only) - Applications | 3 | |
| **V** | **Practical Implementations of Data Structures and its Operations in Java or C Programming Language** | | **30** | **20** |
| | 1 | • Implementation of linear linked list<br>• Implementation of circular linked list<br>• Implementation of doubly linked list<br>• Implementation of BST operations<br>• Implementation of Depth First Search using graph<br>• Implementation of Breadth First Search using graph | 25 | |

| | | | | |
|---|---|---|---|---|
| | | • Implementation of max heap and delete a node from it.<br>• Sort a set of data using Heap tree | | |
| | 2 | Case Study/ Project | 5 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | 3 | 3 | 2 | 1 | | | | | | |
| CO 2 | 1 | 1 | 3 | 3 | 2 | 1 | | | | | | |
| CO 3 | 1 | 1 | 3 | 3 | 2 | 1 | | | | | | |
| CO 4 | 1 | 1 | 3 | 3 | - | - | | | | | | |
| CO 5 | 1 | 1 | 3 | 3 | 3 | 1 | | | | | | |
| CO 6 | 1 | 1 | 3 | 3 | 3 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | ✓ | ✓ |
| CO 2 | ✓ | ✓ | ✓ | ✓ |
| CO 3 | ✓ | ✓ | ✓ | ✓ |
| CO 4 | ✓ | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | ✓ | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 6 | ✓ | ✓ | ✓ | |

**References:**

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley, ISBN: 978-0201000238.

2. Horowitz E and Sahni S, Fundamentals of Data Structures, Computer Science Press, ISBN: 9780716780427.

3. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, ISBN: 0929306406.

4. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, Introduction to Algorithms, 3rd Edition, Prentice Hall of India Private Limited, New Delhi, ISBN: 9780262033848

5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, 1st Edition. Addison Wesley, ISBN: 0534915728

## BCA7CJ402 - Data Science Programming using R

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7CJ402 | | | | |
| Course Title | Data Science Programming using R | | | | |
| Type of Course | Major | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 3 | - | 2 | 75 |
| Pre-requisites | 1. Basic knowledge about Data Science<br>2. Basic knowledge about Programming languages | | | | |
| Course Summary | The R programming course offers a comprehensive overview of the R language, encompassing fundamental principles and practical abilities essential for data analysis and statistical computing. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Demonstrate how to install and configure RStudio | U | C | Instructor-created exams / Quiz |
| CO2 | Apply OOP concepts in R programming | U | C | Practical Assignment / Group Tutorial Work |

| | | | | |
|---|---|---|---|---|
| CO3 | Explain the use of data structure and loop functions | U | C | Practical Assignment / Group Tutorial Work |
| CO4 | Understand the concept of data frames | U | C | Instructor-created exams / Home Assignments |
| CO5 | Implement the DPLYR package and Data Visualization | Ap | P | Practical assignments and practical tests |
| CO6 | Implementation of R Programming concepts | Ap | M | Practical assignments and practical tests |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (45+30) | Marks |
|---|---|---|---|---|
| **I** | **Fundamentals Of R** | | **10** | **10** |
| | 1 | Installation of R & R Studio | 2 | |
| | 2 | Features of Variables, Constants | 2 | |
| | 3 | Operators | 2 | |
| | 4 | Datatypes and R Objects | 2 | |
| | 5 | Accepting Input from keyboard, Important Built-in functions | 2 | |
| **II** | **Vectors, Matrices and Lists** | | **15** | **20** |
| | 6 | Vectors-Accessing elements of a Vector, Operations on Vectors | 3 | |
| | 7 | Vector Arithmetic | 2 | |
| | 8 | Matrices-Accessing elements of a Matrix | 2 | |
| | 9 | Operations on Matrices, Matrix transpose | 3 | |
| | 10 | Creating lists, manipulating list elements, Merging lists | 3 | |

| | | | | |
|---|---|---|---|---|
| | 11 | Converting lists to vectors | 2 | |
| **III** | **Control Statements, Functions and Arrays In R** | | **10** | **20** |
| | 12 | If statement, if…else statement, if else () function, switch () function | 1 | |
| | 13 | repeat loop, while loop, for loop, break statement, next statement | 2 | |
| | 14 | Formal and Actual arguments, Named arguments | 1 | |
| | 15 | Global and local variables, Argument and lazy evaluation of functions | 2 | |
| | 16 | Recursive functions, String and string functions | 2 | |
| | 17 | Creating arrays, Accessing array elements, Calculations across array elements | 2 | |
| **IV** | **Data Manipulation -Dplyr Package And Data Visualization In R** | | **10** | **20** |
| | 18 | R factors and Data Frames, Load data into dataframe | 2 | |
| | 19 | Viewing the data Selecting columns, selecting rows, Reordering the rows | 2 | |
| | 20 | Pipe operator, Group operations | 2 | |
| | 21 | Data Visualization-Bar plot, Plotting categorical data, Stacked bar plot, Histogram | 2 | |
| | 22 | Plot () function and line plot, pie chart / 3D pie chart, Scatter plot, Box plot | 2 | |
| **V** | **Practical Applications** | | **30** | |
| | Implement the following:<br>• Implementation of Vectors, Matrices and Lists<br>• Implementation of Control statements, functions and Arrays<br>• Usage of DPLYR package and data Visualization<br>• Analyze the mtcars dataset by selecting specific columns and visualizing the data using bar plots, histograms, and scatter plots.<br>• Perform vector and matrix operations, including element access, arithmetic operations, and transposition. | | 30 | |

| | | | |
|---|---|---|---|
| | • Implement control statements and loops to check number properties and iterate through sequences.<br>• Define and use functions with named arguments, handle global and local variables, and create a recursive function to calculate factorials.<br>• Utilize the dplyr package for data manipulation with the iris dataset and perform various list operations including merging and converting lists to vectors.<br>Case Study with any Data Set (MNIST/IRIS) | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | - | - | - | - | | | | | | |
| CO 2 | 1 | 2 | 1 | - | - | - | | | | | | |
| CO 3 | 2 | 2 | 2 | 2 | - | 1 | | | | | | |
| CO 4 | 2 | 2 | 2 | 2 | 1 | 2 | | | | | | |
| CO 5 | 3 | 3 | 2 | 2 | 2 | 2 | | | | | | |
| CO6 | 3 | 3 | 3 | 3 | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| CO 1 | | ✓ | | |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | | | ✓ | |
| CO6 | | | ✓ | |

**References:**

1. "The Book of R" by Tilman M. Davies, no starch press (San Francisco)

2. "The Art of R programming" by Norman Matloff, no starch press (San Francisco)

# Basket of Electives (for V, VI Semesters)

# 1. Image Processing

## BCA5EJ301(1) - Fundamentals of Digital Image Processing

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ301(1) | | | | |
| Course Title | Fundamentals of Digital Image Processing | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of mathematics concepts involved in digital image processing algorithms and transformations.<br>2. Familiarity with programming languages such as MATLAB or Python | | | | |
| Course Summary | This course provides a comprehensive understanding of digital image processing fundamentals, covering topics such as pixel structure, image formation, and types of images. Students will learn a range of image processing techniques including intensity transformations, spatial filtering, and frequency domain filtering, along with their applications in various industries such as medical imaging and multimedia systems. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Develop a comprehensive understanding of the principles underlying digital image processing, including image representation and fundamental processing techniques. | U | C | Assignment / Instructor-created exams / Quiz |
| CO2 | Develop proficiency in basic digital image processing techniques, including intensity transformations, spatial filtering, and histogram processing, to manipulate and enhance digital images effectively. | Ap | C | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Analyze the components of digital image processing systems and their functions in image sensing and acquisition, including the use of single sensing elements, sensor strips, and sensor arrays | An | C | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Develop skills in implementing image processing algorithms, including spatial filtering techniques like smoothing and sharpening, as well as frequency domain filtering methods. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Analyze and interpret digital images to extract meaningful information and insights, facilitating informed decision-making in diverse application domains. | An | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Explore advanced concepts and emerging trends in digital image processing, fostering a deeper understanding of the field's evolving landscape and potential future directions. | Ap | C | Practical Assignment / Instructor-created exams / Quiz |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Digital Image and Digital Image Processing** | | **10** | **15** |
| | 1 | Digital image and Digital image processing system, Pixels, Resolution of an image, Types of Images – Gray Scale, Binary and Color Images | 1 | |
| | 2 | Fundamentals steps in digital image processing | 3 | |
| | 3 | Applications of digital image processing | 3 | |
| | 4 | Image processing system components | 3 | |
| **II** | **Image Sensing and Acquisition** | | **12** | **15** |
| | 5 | Image acquisition using a single sensing element, Image | 3 | |

| | | | | |
|---|---|---|---|---|
| | | acquisition using sensor strips, Image acquisition using sensor arrays | | |
| | 6 | A simple image formation model | 3 | |
| | 7 | Basic Concepts in Sampling and Quantization | 2 | |
| | 8 | Representing digital images | 2 | |
| | 9 | Some basic relationships between pixels - neighbors of a pixel, adjacency, connectivity, regions, and boundaries | 2 | |
| **III** | **Intensity Transformation and Spatial Filtering** | | **13** | **20** |
| | 10 | Basics of intensity transformations and spatial filtering | 1 | |
| | 11 | Some basic intensity transformation functions - Image negatives, Log transformations | 1 | |
| | 12 | Piecewise linear transformation functions - Contrast stretching, Intensity-level slicing | 2 | |
| | 13 | Histogram processing, Histogram equalization | 2 | |
| | 14 | Fundamentals of spatial filtering - The mechanics of linear spatial filtering | 1 | |
| | 15 | Spatial correlation and convolution | 2 | |
| | 16 | Smoothing (lowpass) spatial filters - box filter kernels, order-statistic (nonlinear) filters | 2 | |
| | 17 | Sharpening (highpass) spatial filters – The Laplacian, Unsharp masking and highboost filtering, gradient filter | 2 | |
| **IV** | **Frequency Domain Filtering and Image Restoration** | | **13** | **20** |
| | 18 | Filtering in Frequency Domain - The Discrete Fourier Transformation (DFT) | 1 | |
| | 19 | Steps for filtering in the frequency domain, Ideal and Butterworth Low pass and High pass filters | 2 | |
| | 20 | Image Restoration - degradation model, Properties | 1 | |
| | 21 | Noise models, Mean Filters – Order Statistics | 2 | |
| | 22 | Inverse Filtering – Wiener filtering | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | • Relationships between pixels<br>• Intensity transforms<br>• Spatial and Frequency Domain Filtering | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 1 | - | 2 | 2 | | | | | | |
| CO 2 | 1 | - | 1 | - | 2 | 2 | | | | | | |
| CO 3 | 1 | 1 | 1 | - | 2 | 2 | | | | | | |
| CO 4 | 3 | 3 | 2 | 1 | 2 | 1 | | | | | | |
| CO 5 | 1 | - | 1 | - | 2 | 2 | | | | | | |
| CO 6 | 3 | 3 | 1 | 1 | 2 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Gonzalez, Rafael C., and Woods, Richard E. "Digital Image Processing." Pearson Education, Inc., 2008.

2. Jain, Anil K. "Fundamentals of Digital Image Processing." Prentice Hall, 1989.

3. Sonka, Milan, Hlavac, Vaclav, and Boyle, Roger. "Image Processing, Analysis, and Machine Vision." Cengage Learning, 2014.

4. Pratt, William K. "Digital Image Processing: PIKS Scientific Inside." John Wiley & Sons, 2007.

5. Burger, Wilhelm, and Burge, Mark J. "Digital Image Processing: An Algorithmic Approach with MATLAB." Springer, 2017.

6. Woods, Richard E., and Eddins, Steven L. "Digital Image Processing using MATLAB." Gatesmark Publishing, 2010.

# BCA5EJ302(1) - Pattern Recognition

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ302(1) | | | | |
| Course Title | Pattern Recognition | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of probability theory and statistics.<br>2. Prior knowledge of data structures and algorithms. | | | | |
| Course Summary | This course provides a comprehensive overview of pattern recognition, covering fundamental concepts such as statistical decision-making, non-parametric techniques, clustering, and feature selection. Students will develop practical skills in designing and evaluating pattern recognition systems through hands-on implementation of algorithms and analysis of real-world applications. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Demonstrate an understanding of the core principles and concepts of pattern recognition, as well as their diverse applications across various domains. | U | C | Assignment / Instructor-created exams / Quiz |
| CO2 | Apply statistical decision-making methodologies effectively to design and develop robust pattern recognition systems. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Implement and evaluate various pattern recognition models, employing statistical measures for performance assessment. | E | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Explore and employ non-parametric decision-making approaches in pattern recognition tasks to enhance system accuracy and adaptability. | U | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Utilize clustering techniques for data grouping and feature selection, optimizing pattern recognition system efficiency. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Evaluate the performance of pattern recognition systems through | E | P | Practical Assignment / |

| | | | | |
|---|---|---|---|---|
| | comprehensive analysis of error rates, population composition estimation, and other relevant metrics. | | | Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Introduction** | | **8** | **15** |
| | 1 | Pattern Recognition - Basic concepts, Applications | 2 | |
| | 2 | Fundamental problems in pattern recognition system design | 2 | |
| | 3 | Design concepts and methodologies | 2 | |
| | 4 | Simple pattern recognition model | 2 | |
| **II** | **Statistical Decision Making** | | **15** | **20** |
| | 5 | Statistical Decision Making: Introduction, Baye's theorem | 3 | |
| | 6 | Multiple features, Conditionally independent features | 2 | |
| | 7 | Decision boundaries | 2 | |
| | 8 | Unequal cost of error, Estimation of error rates | 2 | |
| | 9 | Leaving-one-out-techniques | 2 | |
| | 10 | Characteristic curves | 2 | |
| | 11 | Estimating the composition of populations | 2 | |
| **III** | **Non-Parametric Decision Making** | | **10** | **15** |
| | 12 | Histogram, Kernel and window estimation, | 2 | |
| | 13 | Nearest neighbour classification techniques | 2 | |
| | 14 | Adaptive decision boundaries | 2 | |
| | 15 | Adaptive discriminant functions | 2 | |
| | 16 | Minimum squared error discriminant functions | 2 | |
| **IV** | **Clustering and Feature Selection** | | **15** | **20** |
| | 17 | Clustering and Feature Selection - Introduction | 2 | |
| | 18 | Aagglomerative clustering algorithm | 3 | |
| | 19 | the single-linkage, Complete-linkage and average-linkage algorithm | 3 | |
| | 20 | K-Means's algorithm | 3 | |
| | 21 | Clustering in feature selection through entropy minimization | 2 | |
| | 22 | Features selection through orthogonal expansion. | 2 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | • Implement a simple pattern recognition model using a programming language/tool (e.g., Python, MATLAB etc.) and write a research paper. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 2 | 2 | 2 | 1 | | | | | | |
| CO 2 | 1 | 2 | 1 | 2 | 2 | 1 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 3 | 2 | 2 | 2 | 3 | 1 | 1 | | | | | | |
| CO 4 | 1 | 2 | 2 | 2 | 2 | 1 | | | | | | |
| CO 5 | 2 | 2 | 2 | 2 | 2 | 1 | | | | | | |
| CO 6 | 1 | 2 | 2 | 2 | 2 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Bishop, C. M. Pattern Recognition and Machine Learning. Springer, 2006.

2. Theodoridis, S., & Pikrakis, A. Introduction to Pattern Recognition: A Matlab Approach. Academic Press, 2010.

3. Duda, R. O., Hart, P. E., & Stork, D. G. Pattern Classification. Wiley-Interscience, 2000.

4. Murphy, K. P. Machine Learning: A Probabilistic Perspective. MIT Press, 2012.

5. Han, J., Kamber, M., & Pei, J. (2011). Data Mining: Concepts and Techniques. Morgan Kaufmann.

6. Hastie, T., Tibshirani, R., & Friedman, J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer, 2009.

## BCA6EJ303(1) - Advanced Digital Image Processing and Computer Vision

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6EJ303(1) | | | | |
| Course Title | Advanced Digital Image Processing and Computer Vision | | | | |
| Type of Course | Elective | | | | |
| Semester | VI | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of mathematics concepts involved in digital image processing algorithms and transformations.<br>2. Familiarity with programming languages such as MATLAB or Python | | | | |
| Course Summary | This course provides a comprehensive understanding of digital image processing fundamentals, covering topics such as pixel structure, image formation, and types of images. Students will learn a range of image processing techniques including intensity transformations, spatial filtering, and frequency domain filtering, along with their applications in various industries such as medical imaging and multimedia systems. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand principles and techniques of morphological image processing. | U | C | Assignment / Instructor-created exams / Quiz |
| CO2 | Gain proficiency in image segmentation methods. | U | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Master thresholding techniques for converting grayscale images into binary images and extracting relevant features. | U | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Acquire knowledge of feature extraction methods for pattern recognition and classification. | U | P | Practical Assignment / Instructor-created exams / Quiz |

| | | | | |
|---|---|---|---|---|
| CO5 | Understand fundamentals of color image processing, including color models. | U | C | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Develop proficiency in image compression techniques for reducing storage space and transmission bandwidth while preserving visual quality. | U | C | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Morphological Image Processing and Image Segmentation** | | **13** | **20** |
| | 1 | Morphological Image Processing - Structuring element, Erosion and Dilation | 2 | |
| | 2 | Opening and Closing | 2 | |
| | 3 | Thinning and Thickening | 2 | |
| | 4 | Image Segmentation – Fundamentals, Point, Line, and Edge Detection | 3 | |
| | 5 | Segmentation by Region Growing | 2 | |
| | 6 | Segmentation by Region Splitting and Merging | 2 | |
| **II** | **Thresholding, Feature Extraction and Color Image Processing** | | **14** | **20** |
| | 7 | Thresholding - Basics of Intensity Thresholding, Basic Global Thresholding | 2 | |
| | 8 | Otsu's algorithm | 2 | |
| | 9 | Feature Extraction – Definition, Statistical Features | 2 | |
| | 10 | Color Image Processing - Color Fundamentals | 2 | |
| | 11 | Color Models – RGB | 2 | |
| | 12 | CMY and CMYK Color Models | 2 | |
| | 13 | Basics of Full-Color Image Processing | 2 | |
| **III** | **Image Compression** | | **10** | **15** |
| | 14 | Image Compression – Fundamentals | 2 | |
| | 15 | Types of data redundancies - Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information | 2 | |
| | 16 | Huffman Coding | 2 | |
| | 17 | Run-length Coding | 2 | |
| | 18 | Neural Networks Machine Learning and Deep Learning (Definitions only) | 2 | |
| **IV** | **Computer Vision** | | **11** | **15** |
| | 19 | Computer Vision – Introduction to Computer Vision | 2 | |
| | 20 | Feature Detection and Matching – Points and Patches, Edges, Lines | 3 | |
| | 21 | Recognition – Object Detection, Face Recognition | 3 | |
| | 22 | Instance Recognition, Category Recognition, Motion Detection | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | • Image segmentation algorithms | 12 | |

| | | | | |
|---|---|---|---|---|
| | | • Thresholding algorithms<br>• Image Compression methods<br>• Face Recognition methods | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 2 | 1 | 2 | 2 | 1 | | | | | | |
| CO 2 | 1 | 2 | 1 | 2 | 2 | 1 | | | | | | |
| CO 3 | 1 | 2 | 1 | 2 | 2 | 1 | | | | | | |
| CO 4 | 3 | 2 | 2 | 2 | 2 | 1 | | | | | | |
| CO 5 | 1 | 2 | 1 | 2 | 2 | 1 | | | | | | |
| CO 6 | 2 | 2 | 1 | 2 | 2 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Gonzalez, Rafael C., and Woods, Richard E. "Digital Image Processing." Pearson Education, Inc., 2008.

2. Jain, Anil K. "Fundamentals of Digital Image Processing." Prentice Hall, 1989.

3. Sonka, Milan, Hlavac, Vaclav, and Boyle, Roger. "Image Processing, Analysis, and Machine Vision." Cengage Learning, 2014.

4. Pratt, William K. "Digital Image Processing: PIKS Scientific Inside." John Wiley & Sons, 2007.

5. Burger, Wilhelm, and Burge, Mark J. "Digital Image Processing: An Algorithmic Approach with MATLAB." Springer, 2017.

6. Szeliski, R. Computer vision: Algorithms and applications. Springer Science & Business Media, 2010.

7. Forsyth, D. A., & Ponce, J. Computer vision: A modern approach. Prentice Hall, 2011.

## BCA6EJ304(1) - Applied Digital Image Processing

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6EJ304(1) | | | | |
| Course Title | Applied Digital Image Processing | | | | |
| Type of Course | Elective | | | | |
| Semester | VI | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Foundation in mathematics and statistics, including linear algebra, calculus, probability theory, and signal processing.<br>2. Proficiency in programming languages such as MATLAB or Python | | | | |
| Course Summary | The course covers a comprehensive study of medical, document, forensic, and satellite image processing, including techniques such as multimodal fusion, image registration, reconstruction, and enhancement, emphasizing the role of advanced algorithms and software tools in diagnosis, treatment planning, document analysis, forensic investigations, and geographic information systems applications. Students will gain practical skills in image processing, programming, and analytical thinking, essential for addressing real-world challenges in healthcare, document management, law enforcement, and environmental monitoring. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive | Knowledge | Evaluation |
|---|---|---|---|---|

| | | Level* | Category# | Tools used |
|---|---|---|---|---|
| CO1 | Develop a comprehensive understanding of various medical imaging modalities and their applications, facilitating informed decision-making in healthcare. | U | C | Assignment / Instructor-created exams / Quiz |
| CO2 | Acquire proficiency in implementing medical image processing techniques to integrate and analyze multiple imaging modalities for enhanced medical image interpretation. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Understand the importance of document and text image processing across diverse fields, enhancing productivity and efficiency in information management and retrieval. | U | F | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Master advanced image processing techniques to enhance clarity and interpretability of digital evidence in forensic investigations. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Develop a thorough understanding of image processing techniques applicable to satellite and aerial imagery, allowing for their effective utilization in diverse applications. | U | C | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Master advanced image processing methods to enhance the quality of satellite and aerial imagery, enabling detailed analysis and interpretation for environmental monitoring, urban planning, and other spatial applications. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Medical Image Processing** | | **14** | **20** |
| | 1 | Medical Images – Functional Modality - X- Ray, CT, MRI, Ultrasound, Anatomical Modality - fMRI, SPECT, PET (Concept only) | 3 | |
| | 2 | Multimodal Medical Image Fusion, Medical Image Registration | 2 | |
| | 3 | Architecture of CAD System - Image pre-processing, Region(s) of Interest (ROI), Feature Extraction Segmentation and Classification | 3 | |
| | 4 | Image Reconstruction and Enhancement | 2 | |
| | 5 | 3D and 4D medical image visualization | 2 | |
| | 6 | Role of Medical Image Processing in diagnosis and treatment planning | 2 | |
| **II** | **Document and Text Image Processing** | | **10** | **15** |

| | | | | |
|---|---|---|---|---|
| | 7 | Importance of Document and Text Image Processing, Document image acquisition, Optical Character Recognition (OCR) | 3 | |
| | 8 | Document structure and layout analysis, Handwriting recognition, Text classification | 3 | |
| | 9 | Document summarization, Content-based document image retrieval, Text indexing | 3 | |
| | 10 | Applications of Document and Text Image Processing. | 1 | |
| **III** | **Forensic Image Processing** | | **14** | **20** |
| | 11 | Types of forensic images - Physical image, Logical image, Targeted image | 2 | |
| | 12 | Contrast enhancement and Noise reduction, Sharpness and edge enhancement, | 2 | |
| | 13 | Geometric and Photometric corrections of forensic images | 2 | |
| | 14 | Color balancing and Calibration, Foreground and Background Segmentation | 2 | |
| | 15 | Detection of sophisticated tampering, Alterations, and Manipulations | 2 | |
| | 16 | Image metadata, Identification of cloned regions, Splicing, and Retouching, Hidden information analysis | 3 | |
| | 17 | Legal considerations and ethical issues in forensic image processing | 1 | |
| **IV** | **Satellite and Aerial Image Processing** | | **10** | **15** |
| | 18 | Remote Sensing, Satellites and Image acquisition, Sensors types - optical, radar and LiDAR | 2 | |
| | 19 | Radiometric and Geometric corrections, Orthorectification and georeferencing of aerial and satellite images | 2 | |
| | 20 | Contrast stretching, Histogram equalization and Filtering techniques for noise reduction and feature enhancement | 2 | |
| | 21 | Multiscale image decomposition, Object-based image analysis, Image differencing, image rationing | 2 | |
| | 22 | Geographic Information Systems (GIS) | 2 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | • Write a review paper either from medical image processing or from Document and Text Image Processing or from Forensic Image Processing or from Satellite and Aerial Image Processing or from any other applied image processing area. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 1 | 1 | 2 | 1 | | | | | | |
| CO 2 | 2 | 3 | 3 | 2 | 2 | 1 | | | | | | |
| CO 3 | 2 | 1 | 1 | 1 | 1 | 2 | | | | | | |
| CO 4 | 2 | 1 | 1 | 1 | 1 | 2 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 5 | 2 | 2 | 1 | 1 | 1 | 2 | | | | | | |
| CO 6 | 2 | 1 | 1 | 1 | 1 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. G.R. Sinha, Bhagwaticharan Patel, Medical Image Processing: Concepts and Applications, PHI Learning private limited.2014

2. KayvanNajarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005

3. Document Image Analysis" by Lawrence O'Gorman and Rangachar Kasturi, 1995, IEEE Computer Society Press.

4. Handbook of Document Image Processing and Recognition" edited by David Doermann, 2014, CRC Press.

5. Digital Image Processing for Forensic Applications" by Rajkumar Kannan and E. Sreekumar, CRC Press, 2013

6. "Forensic Image Processing" by John C. Russ, SPIE Press, 2008.

7. Remote Sensing Digital Image Analysis: An Introduction" by John A. Richards and Xiuping Jia, Springer, 2006.

8. Remote Sensing and Image Interpretation" by Thomas Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, Wiley, 2014.

# 2. Computer Networks

## BCA5EJ301(2) - Wireless Communication

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ301(2) | | | | |
| Course Title | Wireless Communication | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic computer science knowledge<br>2. Familiarity with networking fundamentals and Digital Communication basics. | | | | |
| Course Summary | The Wireless Communications course is designed for the students to gain a comprehensive understanding of wireless communication technologies and their applications. The course covers fundamental concepts, protocols, and technologies that form the basis of modern wireless networks. It explores the evolution from 2G to 5G and beyond, as well as emerging trends such as Internet of Things (IoT) and 6G. Students will also delve into security and privacy considerations in wireless communications. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Define the fundamental concepts of wireless communication technologies. | R | F | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | Explain the evolution and standards of wireless networks. | U | C | Practical Assignment / Instructor-created |

| | | | | |
|---|---|---|---|---|
| | | | | exams / Quiz |
| CO3 | Apply knowledge of wireless protocols to design and configure wireless networks. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Analyze the security threats in wireless communication systems and propose countermeasures. | An | M | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Evaluate the impact of emerging trends in wireless communications on industry demands and ethical considerations. | E | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Design and develop innovative solutions for challenges in the field of wireless communications. | C | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction to Wireless Transmission** | **13** | **18** |
| | 1 | Applications of wireless networks | 1 | |
| | 2 | History of wireless communication | 2 | |
| | 3 | Simplified Reference Model | 2 | |
| | 4 | Frequencies for radio transmission, signals, Antennas | 3 | |
| | 5 | Signal propagation and Multiplexing | 2 | |
| | 6 | Modulation, Spread Spectrum, Cellular systems | 3 | |
| **II** | | **Medium Access Control & Telecommunications Systems** | **12** | **17** |
| | 7 | Motivation for specialized MAC | 2 | |
| | 8 | SDMA, FDMA | 2 | |
| | 9 | TDMA, CDMA | 3 | |
| | 10 | GSM-Mobile Services, Architecture, Protocols | 3 | |
| | 11 | DECT-System & Protocol Architecture | 2 | |
| **III** | | **Satellite Systems & Wireless LANs** | **12** | **18** |
| | 12 | Satellite systems, Basics- GEO, LEO, MEO | 2 | |
| | 13 | Routing, Localization & Handover | 2 | |
| | 14 | Infra-red vs radio transmission | 2 | |
| | 15 | Infrastructure and ad-hoc network | 2 | |
| | 16 | IEEE 802.11 | 2 | |
| | 17 | Bluetooth | 2 | |
| **IV** | | **Mobile Network & Transport Layer** | **11** | **17** |
| | 18 | Mobile IP, DHCP | 3 | |
| | 19 | Mobile Ad-hoc networks | 2 | |
| | 20 | Traditional TCP | 3 | |
| | 21 | Classical TCP Improvements | 2 | |

| | | | | |
|---|---|---|---|---|
| | 22 | TCP over 2.5/3G wireless networks | 1 | |
| **V** | **Open Ended Module – Support for Mobility** | | **12** | |
| | | • Various file systems such as NFS, AFS, Coda, Little Work, Ficus, Mio-NFS, Rover, etc.<br>• World Wide Web- Problems and solutions when used in mobile and wireless environment.<br>• Wireless Application Protocols, architecture, Wireless Transaction Protocols, Markup language, Session Protocol, etc.<br>• 4G, 5G, 6G and beyond: Future wireless Technologies<br>• IOT, Green Wireless Communications, Machine-to-Machine (M2M) communications. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | - | - | - | 1 | | | | | | |
| CO 2 | 1 | 2 | - | - | - | 1 | | | | | | |
| CO 3 | 2 | 3 | 3 | 2 | 2 | 2 | | | | | | |
| CO 4 | 2 | 3 | 3 | - | 2 | 2 | | | | | | |
| CO 5 | 3 | 2 | 2 | - | 3 | 3 | | | | | | |
| CO 6 | 2 | 3 | 3 | 1 | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. "Mobile Communications" by Jochen H. Schiller, 2/e, Pearson Education, 2012.

2. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport.

3. "Wireless Communications and Networks" by William Stallings.

4. “Wireless Communications” by Andrea Goldsmith, Cambridge University Press, 2005.

5. "5G NR: The Next Generation Wireless Access Technology" by Erik Dahlman, Stefan Parkvall, and Johan Skold.

## BCA5EJ302(2) - Cryptography and Network Security

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ302(2) | | | | |
| Course Title | Cryptography and Network Security | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic understanding of computer networks, cryptography, and programming concepts. Familiarity with OSI model, encryption algorithms, and network security mechanisms recommended. | | | | |
| Course Summary | Cryptography and Network Security course provides a comprehensive overview of security principles and encryption techniques essential for securing computer networks. Upon completion, students will possess the knowledge and skills to analyse, implement, and maintain secure network environments, addressing contemporary security challenges effectively. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the | U | F | Quizzes, |

| | | | | |
|---|---|---|---|---|
| | fundamental principles of cryptography | | | Assignments/Instructor-created exams |
| CO2 | Analyse security vulnerabilities in network systems | An | C | Case studies, Projects, Instructor-created exams |
| CO3 | Design and implement secure communication protocols | Ap | P | Coding exercises, Projects |
| CO4 | Evaluate cryptographic techniques for different applications | E | C | Research papers, Critical reviews, Instructor-created exams/Quizzes |
| CO5 | Apply cryptographic principles to real-world scenarios | Ap | P | Simulations, Scenario-based assessments, Presentations, Quizzes |
| CO6 | Critically assess emerging trends and technologies in cryptography and network security | E | C | Projects, Industry Internships, Instructor-created exams/Quizzes |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| **I** | **Introduction To Security and Traditional Symmetric Key Encryption Techniques** | | **11** | **15** |
| | 1 | **Introduction To Security:** The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Cryptology, A Model for Network Security. | 3 | |
| | 2 | **Symmetric Cipher Model-** Cryptography, Cryptanalysis and Brute-Force Attacks | 2 | |
| | 3 | **Substitution Techniques -** Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One Time Pad Cipher. | 3 | |
| | 4 | **Transposition Techniques –** Rail Fence | 1 | |
| | 5 | **Rotor Machines-** Basic Principle and Working | 1 | |
| | 6 | **Steganography-** Purpose, Techniques | 1 | |
| **II** | **Modern Symmetric Key Encryption Techniques** | | **15** | **15** |
| | 7 | **Stream Ciphers and Block Ciphers-** Definitions, Difference, Block Cipher Structure - Feistel Cipher - Structure, Encryption and Decryption. | 3 | |
| | 8 | **Data Encryption Standard (DES) –** Encryption, Decryption, Example, Strength Of DES | 3 | |
| | 9 | **Advanced Encryption Standard (AES) –** Encryption and Decryption, Transformation functions, Key Expansion, Example | 2 | |

| | | | | |
|---|---|---|---|---|
| | 10 | **Block Cipher Modes of Operations-** Electronic Code Mode, Book Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode | 3 | |
| | 11 | **Stream Cipher –** Structure, RC4 | 4 | |
| **III** | **Asymmetric Cipher and Cryptographic Data Integrity Algorithms** | | **11** | **20** |
| | 12 | **Public Key Cryptography (Asymmetric Cryptography) –** Encryption and Decryption | 2 | |
| | 13 | **RSA Algorithm –** Introduction, Encryption and Decryption, Example, Advantage and Disadvantage | 2 | |
| | 14 | **Cryptographic Hash Functions –** Concept, Applications | 2 | |
| | 15 | **Secure Hash Algorithm-** SHA 512 | 1 | |
| | 16 | **Message Authentication Code –** Concept, Requirements, Security | 1 | |
| | 17 | **MACs based on Hash Functions-** HMAC | 3 | |
| **IV** | **Network and Internet Security** | | **11** | **20** |
| | 18 | **Web Security Considerations-** Web Security Threats Web Traffic Security Approaches | 1 | |
| | 19 | **Secure Socket Layer and Transport Layer Security-** Concept, Working of SSL and TLS, Difference between SSL and TLS | 3 | |
| | 20 | **HTTPS -** Concept**,** Connection Initiation Connection Closure | 1 | |
| | 21 | **SSH-** Concept, Transport Layer Protocol User Authentication Protocol Connection Protocol | 2 | |
| | 22 | **Electronic Mail Security –** PGP, S/MIME | 4 | |
| **V** | **Open Ended Module- System Security** | | **12** | |
| | | • Intruders<br>• Malicious Software<br>• Firewalls | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | - | 2 | - | 1 | - | | | | | | |
| CO2 | 1 | 1 | 2 | 3 | - | - | | | | | | |
| CO3 | - | 2 | 3 | 3 | - | 1 | | | | | | |
| CO4 | - | - | 1 | 2 | 2 | 2 | | | | | | |
| CO5 | - | 2 | - | - | 1 | 1 | | | | | | |
| CO6 | - | 2 | - | 2 | - | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ |
| CO3 | | ✓ | ✓ | ✓ |
| CO4 | | ✓ | | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | ✓ | ✓ | ✓ |

**References:**

1. Cryptography And Network Security Principles and Practice, William Stallings, Pearson Education- Fifth Edition
2. Cryptography and Network Security, Behrouz A. Forouzan Tata, McGraw-Hill.
3. Cryptography and Network Security, Atul Kahate, Tata McGraw Hill,2019.
4. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

## BCA6EJ303(2) - Storage Area Network

| | |
|---|---|
| Programme | Bachelor of Computer Applications (BCA) |
| Course Code | BCA6EJ303(2) |
| Course Title | Storage Area Network |
| Type of Course | Elective |
| Semester | VI |
| Academic Level | 300-399 |

| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
|---|---|---|---|---|---|
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of computer networks<br>2. Familiarity with operating systems and file systems | | | | |
| Course Summary | This course provides an in-depth understanding of Storage Area Networks (SANs) and their role in modern computing environments. Students will explore the fundamental concepts, architectures, protocols, and implementation strategies of SANs. Practical aspects of designing, managing, and troubleshooting SANs will also be covered. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Define the fundamental concepts and components of Storage Area Networks (SANs), describe the evolution of storage architectures and the role of SANs in modern computing environments. | U | C | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | Design a basic Storage Area Network (SAN) architecture, considering storage devices, Fibre Channel technology, and SAN fabric components, implement zoning and LUN masking for secure and efficient data access in a SAN. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Evaluate and compare different SAN protocols, including Fibre Channel Protocol (FCP), iSCSI, FCIP, and FCoE, analyze and troubleshoot common issues in SANs, applying knowledge of SAN components and protocols. | An | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Devise strategies for RAID configurations and data migration in a SAN, develop a comprehensive SAN security plan, integrating authentication, access control, and encryption. | R | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Assess the performance of a Storage Area Network, identifying bottlenecks and implementing optimization techniques, critically evaluate emerging trends in SANs, such as basic, advanced and Backup software. | E | F | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Demonstrate practical skills in designing, managing, and troubleshooting a Storage Area Network | C | P | Practical Assignment / Instructor- |

| | | | | |
|---|---|---|---|---|
| | through hands-on projects, communicate effectively about SAN concepts, protocols, and best practices in both written and oral formats. | | | created exams / Quiz |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | | **Networking and Storage Concepts** | **10** | **15** |
| | 1 | OSI reference model | 1 | |
| | 2 | Common network devices, Network Topologies | 3 | |
| | 3 | MAC standards | 2 | |
| | 4 | Need for Storage Networks, Storage Devices and Techniques | 2 | |
| | 5 | SAN Components and Building Blocks | 2 | |
| **II** | | **Fibre Channel and SAN Fundamentals** | **12** | **20** |
| | 6 | Fibre Channel Topologies, Fibre Channel Layers | 3 | |
| | 7 | Classes of Services, SAN topologies | 3 | |
| | 8 | SAN Operating Systems, software and hardware | 2 | |
| | 9 | Types of SAN technology | 2 | |
| | 10 | SAN Protocols- FCP, iSCSI, FCIP, FCoE | 2 | |
| **III** | | **Storage networking architecture** | **13** | **20** |
| | 11 | Storage in storage Networking- challenges, cost, performance | 1 | |
| | 12 | Keeping SAN storage Up & working | 2 | |
| | 13 | Network in storage Networking | 2 | |
| | 14 | Emerging SAN interconnect Technologies | 2 | |
| | 15 | Basic software for Storage Networking | 3 | |
| | 16 | File systems and Application Performances | 3 | |
| **IV** | | **Advanced and Backup softwares for SAN** | **13** | **15** |
| | 17 | Advanced software for storage Networking- Data Replication | 3 | |
| | 18 | Synchronous & Asynchronous Replication | 2 | |
| | 19 | Cluster Data Models | 2 | |
| | 20 | Enterprise Backup Software for SAN | 2 | |
| | 21 | Enterprise Backup Architecture and Policies | 3 | |
| | 22 | Minimizing the Impact of Backup | 1 | |
| **V** | | **Open Ended Module – Design and Building a SAN** | **12** | |
| | 1 | • Design considerations and business requirements<br>• Physical layout, placement, storage, pooling<br>• Data availability, connectivity, scalability, migration, manageability<br>• Fault Tolerance and resilience, Prevention of Congestion<br>• SAN security- basic security guidelines, future of SANS. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 1 | - | 3 | - | | | | | | |
| CO 2 | 1 | 2 | 1 | - | 3 | - | | | | | | |
| CO 3 | 3 | 1 | 1 | - | 3 | - | | | | | | |
| CO 4 | 3 | 1 | 1 | - | 3 | - | | | | | | |
| CO 5 | 3 | - | 1 | 1 | 3 | - | | | | | | |
| CO 6 | 3 | - | 1 | 1 | 3 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Meeta Gupta, Storage Area Network Fundamentals, Cisco Press.

2. Richard Barker and Paul Massiglia, Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs, Wiley India Pvt Ltd.

3. John R. Vacca, The Essential Guide to Storage Area Networks, 1st Edition, Prentice Hall.

4. Christopher Poelke and Alex Nikitin, Storage Area Networks for Dummies, 2nd Edition.

5. Tom Clark, Designing Storage Area Networks: A Practical Reference for Implementing Fibre Channel and IP SANs, 2nd Edition, Addison Wesley Professional.

6. Robert Spalding, Storage Networks: The Complete Reference, 1st Edition, Tata McGraw-Hill Education.

## BCA6EJ304(2) - Internet of Things

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6EJ304(2) | | | | |
| Course Title | Internet of Things | | | | |
| Type of Course | Elective | | | | |
| Semester | VI | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of computer science concepts.<br>2. Familiarity with networking fundamentals.<br>3. Proficiency in a programming language (e.g., Python, Java). | | | | |
| Course Summary | A course on the Internet of Things (IoT) typically covers a range of topics to provide students with a comprehensive understanding of this interdisciplinary field like Basic concepts and Components of an IoT system, IOT Architecture and communication protocols, IOT devices and Sensors, IOT security, Data management and Applications | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | The course enables student tounderstand the basics of Internet of things and protocols. It introduces some of the application areas where Internet of Things can be applied. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things. | U | P | Assignment / Instructor-created exams / Quiz |
| CO2 | Define and articulate the fundamental concepts and principles of the Internet of Things. | R | P | Assignment / Instructor-created exams / |

| | | | | |
|---|---|---|---|---|
| | | | | Quiz |
| CO3 | Understand the role of edge computing and fog computing in IoT architectures. | U | P | Assignment / Instructor-created exams / Quiz |
| CO4 | Identify and address security challenges in IoT systems. | An | P | Assignment / Instructor-created exams / Quiz |
| CO5 | Manage data generated by IoT devices, including collection, storage, and processing. | Ap | P | Assignment / Instructor-created exams / Quiz |
| CO6 | Identify and analyse industry-specific applications of IoT in areas such as healthcare, smart cities, agriculture, and manufacturing | An | P | Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to IoT** | | **10** | **12** |
| | 1 | Definition and characteristics of IoT | 2 | |
| | 2 | Components of IoT | 2 | |
| | 3 | Embedded Systems | 3 | |
| | 4 | Basics of IoT Networking | 3 | |
| **II** | **IoT protocols** | | **12** | **18** |
| | 5 | Protocol Standardization for IoT | 3 | |
| | 6 | SCADA and RFID Protocols | 3 | |
| | 7 | M2M and WSN Protocols | 2 | |
| | 8 | Issues with IoT Standardization | 2 | |
| | 9 | IOT security and Liability | 2 | |
| **III** | **IoT Architecture** | | **13** | **20** |
| | 10 | Components of IOT architecture | 1 | |
| | 11 | Stages of IOT solutions Architecture | 2 | |
| | 12 | Layers of IOT Architecture | 2 | |
| | 13 | IoT Open-source architecture (OIC) | 2 | |
| | 14 | OIC Architecture & Design principles | 3 | |
| | 15 | IoT Devices and deployment models | 3 | |
| **IV** | **IoT Data Management** | | **13** | **20** |
| | 16 | Data collection, storage, and processing in IoT | 1 | |
| | 17 | Data analytics techniques for IoT data. | 2 | |
| | 18 | Ethical considerations in IoT design and deployment. | 1 | |
| | 19 | Cloud Computing for IoT | 2 | |
| | 20 | Overview of cloud platforms for IoT solutions | 3 | |
| | 21 | IoT data management and analytics in the cloud. | 1 | |
| | 22 | Existing IoT platforms /middleware, IoT- A, Hydra etc | 3 | |

| | | | | |
|---|---|---|---|---|
| **V** | **Capstone Project: Case studies based on IOT APPLICATIONS** | | **12** | |
| | | ▪ IoT applications for industry, Environment, Marketing<br>▪ Healthcare, smart cities, agriculture, and manufacturing. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | - | 1 | - | 3 | - | | | | | | |
| CO 2 | 1 | - | 1 | - | 3 | - | | | | | | |
| CO 3 | 3 | - | 1 | - | 3 | - | | | | | | |
| CO 4 | 3 | - | 1 | - | 3 | - | | | | | | |
| CO 5 | 3 | - | 1 | - | 3 | - | | | | | | |
| CO 6 | 3 | - | 1 | - | 3 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.

2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.

5. David Hanes, Gonzalo Salgueiro, Patrick Grossetete "IOT Fundamentals: Networking Technologies, protocols and use cases for the internet of Things"

6. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
7. Adrian McEwen and Kakim Cassimally, "Designing the Internet of Things"

# 3. Cloud Computing

## BCA5EJ301(3) - Cloud Computing

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ301(3) | | | | |
| Course Title | Cloud Computing | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic understanding of computer networks, operating systems, and programming. | | | | |
| Course Summary | This course introduces students to the fundamental concepts, technologies, and practices of cloud computing. It covers the basics of cloud infrastructure, deployment models, and service models. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand fundamentals of cloud | U | C | Instructor- |

| | | | | |
|---|---|---|---|---|
| | Computing | | | created exams / Quiz |
| CO2 | Describe and compare Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) | U | C | Assignment / Seminar presentations/ Exams |
| CO3 | Analyze various deployment models such as public, private, and hybrid clouds. | U | P | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Understand the principles of virtualization and its role in cloud computing. | U | C | Instructor-created exams / Home Assignments |
| CO5 | Compare and contrast different virtualization technologies, including hypervisors and containerization. | U | P | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Explore various cloud platforms in industry | U | F | Case Study/ Exams |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Cloud Computing** | | **8** | **12** |
| | 1 | Cloud computing in a glance | 2 | |
| | 2 | Historical context and evolution | 1 | |
| | 3 | Building cloud computing environments- Cloud components | 2 | |
| | 4 | Desired features of cloud | 2 | |
| | 5 | Advantages of Cloud | 1 | |
| **II** | **Cloud Computing Architecture** | | **14** | **20** |
| | 6 | Cloud reference model | 4 | |
| | 7 | Types of cloud- private, public, hybrid, community | 3 | |
| | 8 | Cloud service models (IaaS) | 2 | |
| | 9 | Cloud service models (PaaS) | 2 | |
| | 10 | Cloud service models (SaaS) | 2 | |
| | 11 | Open Challenges | 1 | |
| **III** | **Virtualization Technologies** | | **16** | **23** |
| | 12 | Virtual machine basics | 2 | |
| | 13 | hypervisor | 2 | |
| | 14 | Virtualisation structure | 3 | |
| | 15 | Implementation levels of virtualisation | 2 | |
| | 16 | Virtualisation types- Full Virtualisation, Para Virtualisation, Hardware Virtualisation | 3 | |
| | 17 | Virtualisation of CPU, Memory | 2 | |

| | | | | |
|---|---|---|---|---|
| | 18 | Virtualisation of I/O devices | 2 | |
| **IV** | **Virtualisation Infrastructure & Dockers** | | **10** | **15** |
| | 17 | Desktop Virtualisation, Network Virtualisation & Storage Virtualisation | 2 | |
| | 18 | Containers vs Virtual Machines | 2 | |
| | 19 | Basics of Dockers | 2 | |
| | 20 | Docker Components | 2 | |
| | 21 | Docker Containers | 1 | |
| | 22 | Docker Images and repositories | 1 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | Cloud platforms in Industry<br>• **Amazon web services**- computation services, storage services, communication services<br>• **Google AppEngine**- Architecture and core concepts<br>• **Microsoft Azure**- Azure core concepts | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | -- | 2 | -- | - | 1 | 1 | | | | | | |
| CO 2 | - | 2 | - | - | 1 | 1 | | | | | | |
| CO 3 | - | 1 | - | - | 1 | 1 | | | | | | |
| CO 4 | - | 1 | - | - | 2 | 1 | | | | | | |
| CO 5 | 1 | 1 | - | - | 2 | 1 | | | | | | |
| CO 6 | - | 1 | - | - | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |
| CO 4 | | ✓ | ✓ |
| CO 5 | | ✓ | ✓ |
| CO 6 | | ✓ | |

**References**

1. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, 2nd Edition, Willey Publications", William Voorsluys, James Broberg, Rajkumar Buyya.

2. "Cloud Computing: A Hands-On Approach" by Arshdeep Bahga and Vijay Madiset.

## BCA5EJ302(3) - Security and Privacy in Cloud

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ302(3) | | | | |
| Course Title | Security and Privacy in Cloud | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic understanding of computer networks, operating systems, databases, Cloud computing | | | | |
| Course Summary | This course explores the security and privacy challenges in cloud computing environments. Students will learn about the fundamental principles, technologies, and best practices for ensuring the confidentiality, integrity, and availability of data in the cloud. The course also covers legal and ethical considerations related to privacy in cloud computing. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand fundamentals of security concepts (encryption, decryption) | U | C | Instructor-created exams / Quiz |
| CO2 | Understand security design principles. | U | C | Assignment / Seminar presentations/ Exams |
| CO3 | Analyze various threats to cloud security | U | P | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Understand various cloud security design patterns. | U | C | Instructor-created exams / Home Assignments |
| CO5 | Explore various access control mechanisms and management schemes to ensure security in cloud. | U | P | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Explore various levels of security in cloud infrastructure | U | F | Case Study/ Exams |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Fundamentals of Security in Cloud** | | **14** | **22** |
| | 1 | Overview of Cloud Security- Security services- Confidentiality, Integrity, Authentication, Non repudiation, Access control | 2 | |
| | 2 | Basics of Cryptography | 2 | |
| | 3 | Conventional and public key cryptography | 4 | |
| | 4 | Hash functions | 2 | |
| | 5 | Authentications | 2 | |
| | 6 | Digital Signature | 2 | |
| **II** | **Security Design and Architecture for Cloud** | | **12** | **18** |
| | 7 | Security design principles for cloud computing- comprehensive data protection, end to end access control | 2 | |
| | 8 | Common attack vectors and threats | 1 | |
| | 9 | Network and storage- Secure Isolation strategies, Virtualisation strategies, inter- tenant network segmentation strategies, data protection strategies | 3 | |
| | 10 | Data retention, detection and archiving procedures for tenant data | 2 | |
| | 11 | Encryption, Redaction, Tokenisation, Obfuscation | 2 | |

| | | | | |
|---|---|---|---|---|
| | 12 | PKI and key | 2 | |
| **III** | **Access Control and Identity Management** | | **12** | **18** |
| | 13 | Access control requirements for Cloud infrastructure- user identification, authentication and authorization | 2 | |
| | 14 | Role based access control- multi-factor authentication, single Sign-on | 2 | |
| | 15 | Identity providers and service consumers | 2 | |
| | 16 | Storage and network access control options- OS Hardening and minimization | 3 | |
| | 17 | Intruder detection and prevention | 3 | |
| **IV** | **Cloud Security Design patterns** | | **10** | **12** |
| | 18 | Introduction to design patterns | 2 | |
| | 19 | Cloud bursting | 2 | |
| | 20 | Geo-tagging | 2 | |
| | 21 | Secure cloud interfaces | 2 | |
| | 22 | Cloud resource access control | 2 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | Infrastructure security: Network level, host level, application level | 4 | |
| | 2 | Security management in the cloud | 4 | |
| | 3 | Audit and compliance | 4 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | 2 | -- | - | 1 | 1 | | | | | | |
| CO 2 | - | 2 | - | - | 1 | 1 | | | | | | |
| CO 3 | - | 1 | - | - | 1 | 1 | | | | | | |
| CO 4 | - | 1 | - | - | 2 | 1 | | | | | | |
| CO 5 | 1 | 1 | - | - | 2 | 1 | | | | | | |
| CO 6 | - | 1 | - | - | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar

- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |
| CO 4 | | ✓ | ✓ |
| CO 5 | | ✓ | ✓ |
| CO 6 | | ✓ | |

**References:**

1. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" by Tim Mather, Subra Kumaraswamy, and Shahed Latif.

2. “Cloud computing: Principles and Paradigms”. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Willey Publications.

## BCA6EJ303(3) - Storage Technologies

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6EJ303(3) | | | | |
| Course Title | Storage Technologies | | | | |
| Type of Course | Elective | | | | |
| Semester | VI | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic knowledge of computer systems and architecture<br>Fundamental understanding of data structures and algorithms | | | | |
| Course Summary | This course introduces students to various storage technologies, storage network technologies, storage and virtualization technologies. Course also discuss various back up and recovery strategies. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand fundamentals of | U | C | Instructor- |

| | | | | |
|---|---|---|---|---|
| | Information storage | | | created exams / Quiz |
| CO2 | Examine features of various storage architectures | U | C | Assignment / Seminar presentations/ Exams |
| CO3 | Understand features of Intelligent storage systems | U | P | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Identify features of various Storage technologies | U | C | Instructor-created exams / Home Assignments |
| CO5 | Identify need of backup and recovery and various recovery mechanisms | U | P | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Infer security needs and management needs for storage technologies | U | F | Case Study/ Exams |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Storage System** | | **12** | **18** |
| | 1 | **Introduction to Information Storage-** Information Storage, Evolution of Storage Architecture | 2 | |
| | 2 | Data Center Infrastructure and characteristics | 1 | |
| | 3 | Third platform technologies- Cloud storage and its characteristics | 2 | |
| | 4 | Cloud services and deployment models | 3 | |
| | 5 | Storage Architectures- Direct-Attached Storage (DAS) Network-Attached Storage (NAS) (Introduction only) | 2 | |
| | 6 | Storage Area Network (SAN) Cloud storage architectures (Introduction only) | 2 | |
| **II** | **Intelligent Storage Systems & RAID** | | **12** | **18** |
| | 7 | RAID Implementation Methods, RAID Array Components, RAID Techniques | 2 | |
| | 8 | RAID Levels, RAID Impact on Disk Performance | 3 | |
| | 9 | RAID Comparison | 1 | |
| | 10 | Components of an Intelligent Storage System | 1 | |
| | 11 | Storage Provisioning | 2 | |
| | 12 | Types of Intelligent Storage Systems | 3 | |
| **III** | **Storage Networking Technologies - Fibre Channel Storage Area Networks** | | **12** | **18** |

| | | | | |
|---|---|---|---|---|
| | 13 | Block based stored system, File based storage system, object oriented based storage system (Introduction) | 2 | |
| | 14 | Fibre Channel Storage Area Networks- Components of FC SAN, | 2 | |
| | 15 | Fibre Channel Architecture | 2 | |
| | 16 | Fabric Services | 2 | |
| | 17 | FC SAN Topologies | 2 | |
| | 18 | Virtualization in SAN | 2 | |
| **IV** | **Backup and Archive** | | **12** | **16** |
| | 19 | Backup Purpose, Backup Considerations, Back up Granularity | 3 | |
| | 20 | Recovery Considerations, Backup Methods | 3 | |
| | 21 | Backup Architecture, Backup Topologies | 3 | |
| | 22 | Backup and Restore Operations | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | Storage Security Domains | 3 | |
| | 2 | Security Implementations in Storage Networking | 3 | |
| | 3 | Securing Storage Infrastructure in Virtualized and Cloud Environments | 3 | |
| | 4 | Storage Infrastructure Management Activities | 3 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | 2 | -- | - | 1 | 1 | | | | | | |
| CO 2 | - | 2 | - | - | 1 | 1 | | | | | | |
| CO 3 | - | 1 | - | - | 1 | 1 | | | | | | |
| CO 4 | - | 1 | - | - | 2 | 1 | | | | | | |
| CO 5 | 1 | 1 | - | - | 2 | 1 | | | | | | |
| CO 6 | 2 | - | - | - | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | |

**References**

1. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, 2nd Edition, Willey Publications

## BCAEJ304(3) – Virtualization

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCAEJ304(3) | | | | |
| Course Title | Virtualization | | | | |
| Type of Course | Elective | | | | |
| Semester | VI | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic understanding of cloud computing | | | | |
| Course Summary | This course introduces students to the fundamental concepts, technologies, virtualization, various virtualization tools and virtualization in storage, desktop, network and server | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand basics of virtualization | U | C | Instructor-created exams / Quiz |
| CO2 | Understand how hypervisors work and their role in virtualization. | Ap | P | Assignment / Seminar presentations/ |

| | | | | |
|---|---|---|---|---|
| | | | | Exams |
| CO3 | Understand Differences between various types of virtualization, including server virtualization, desktop virtualization, network virtualization, and storage virtualization | Ap | C | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Explore how virtualization technologies are used in the context of cloud services. | U | P | Instructor-created exams / Home Assignments |
| CO5 | Understand the potential risks and vulnerabilities associated with virtualization and learn how to mitigate them. | U | P | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Compare and analyse various virtualization tools | U | F | Case Study/ Exams |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction to Virtualisation** | **12** | **18** |
| | 1 | Virtualization and computing- need for virtualisation, | 2 | |
| | 2 | Cost, administration, | 2 | |
| | 3 | Fast deployment, reduce infrastructure cost | 2 | |
| | 4 | Limitations | 1 | |
| | 5 | Types of hardware virtualization: full virtualisation, partial virtualization, paravirtualization | 3 | |
| | 6 | Types of hypervisors | 2 | |
| **II** | | **Server and Desktop Virtualization** | **14** | **20** |
| | 7 | Virtual machine basics | 2 | |
| | 8 | Types of virtual machines | 2 | |
| | 9 | Understanding server virtualisation- types of server virtualization | 3 | |
| | 10 | Business cases for server virtualization | 2 | |
| | 11 | Uses of virtual server consolidation, | 2 | |
| | 12 | Selecting server virtualisation platform | 1 | |
| | 13 | Desktop virtualisation- types of desktop virtualization | 2 | |
| **III** | | **Network Virtualisation** | **12** | **18** |
| | 14 | Introduction to network virtualisation | 2 | |
| | 15 | Advantages, functions | 2 | |
| | 16 | Tools for network virtualization | 3 | |
| | 17 | VLAN-WAN architecture | 2 | |
| | 18 | WAN Visualization | 3 | |
| **IV** | | **Storage Virtualization** | **10** | **16** |
| | 19 | Introduction to memory virtualization | 2 | |
| | 20 | Types of storage virtualization | 3 | |
| | 21 | Risk of storage virtualization | 2 | |

| | | | | |
|---|---|---|---|---|
| | 22 | SAN-NAS-RAID | 3 | |
| **V** | **Open Ended Module- Virtualization tools (Any 3- 4 hours each)** | | **12** | |
| | | • VMWare-Amazon AWS<br>• Microsoft HyperV<br>• Oracle VM Virtual box<br>• IBM PowerVM<br>• Google Virtualization | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | 2 | -- | - | 1 | 1 | | | | | | |
| CO 2 | - | 2 | - | - | 1 | 1 | | | | | | |
| CO 3 | - | 1 | - | - | 1 | 1 | | | | | | |
| CO 4 | 2 | 1 | - | - | 2 | 1 | | | | | | |
| CO 5 | - | 1 | - | - | 2 | 1 | | | | | | |
| CO 6 | 1 | 1 | - | - | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |

| | | | |
|---|---|---|---|
| CO 4 | | ✓ | ✓ |
| CO 5 | | ✓ | ✓ |
| CO 6 | ✓ | ✓ | |

**References**

1. Cloud Computing a practical approach- Anthony T Velte, Toby T Velte, Robert Elsenpeter, Tata McGraw Hill
2. Virtualization from Desktop to the Enterprise, Chris Wolf, Eric M Halter

# 4. Data Science and AI

## BCA5EJ301(4) - Data Analytics and Visualization

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ301(4) | | | | |
| Course Title | Data Analytics and Visualization | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basics of Linear Algebra<br>2. Basics of Statistics | | | | |
| Course Summary | The data analytics course delves into techniques for analyzing data and extracting valuable insights, preparing participants for effective decision-making based on data-driven evidence across various domains. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Explain the basic concepts of data analytics | U | C | Instructor-created exams / Quiz |
| CO2 | Understand the supervised learning algorithms and its application | U | C | Practical Assignment / Group Tutorial Work |
| CO3 | Understand the unsupervised learning algorithms and its application | U | C | Practical Assignment / Group Tutorial Work |

| | | | | |
|---|---|---|---|---|
| CO4 | Enhance the idea of Big data Anaytics tools | U | C | Instructor-created exams / Home Assignments |
| CO5 | Implementation of Predictive and non predictive algorithms | Ap | P | Practical assignments and practical tests |
| CO6 | Apply data analytics techniques to real-world datasets and case studies from various domains. | Ap | P | Practical assignments and practical tests |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| **I** | **Introduction to Data Analytics** | | **10** | **10** |
| | 1 | Introduction to Data Analysis - Analytics, Analytics Process Model | 2 | |
| | 2 | Analytical Model Requirements. | 2 | |
| | 3 | Data Analytics, Life Cycle overview | 2 | |
| | 4 | Basics of data collection | 2 | |
| | 5 | Sampling, Pre-processing and dimensionality reduction | 2 | |
| **II** | **Supervised learning** | | **16** | **20** |
| | 6 | Regression | 3 | |
| | 7 | Classification | 3 | |
| | 8 | Naive Bayes | 3 | |
| | 9 | KNN | 3 | |
| | 10 | Linear Regression | 2 | |
| | 11 | Application of supervised learning | 2 | |
| **III** | **Unsupervised learning** | | **10** | **20** |
| | 12 | Hierarchical clustering | 2 | |
| | 13 | K-means clustering | 2 | |
| | 14 | Principal Component Analysis | 2 | |
| | 15 | Association- Apriori Algorithm | 2 | |
| | 16 | Application of unsupervised learning | 2 | |
| **IV** | **Big Data Analytics** | | **12** | **20** |
| | 17 | Working of Big Data Analytics | 2 | |
| | 18 | Types of Big Data Analytics | 2 | |
| | 19 | Big Data Analytics Technologies and Tools | 2 | |
| | 20 | Big Data Analytics using Map Reduce and Apache Hadoop | 2 | |
| | 21 | Statistical Method for Visualization | 2 | |
| | 22 | Introduction to Big Data Analytics using Apache Cassandra, Mongo DB | 2 | |
| **V** | **Open Ended Module** | | **12** | |

| | | | |
|---|---|---|---|
| | Implement the tasks from the following:<br>• Apply the entire data analytics process to a real-world dataset.<br>• Perform clustering and association rule mining on a market basket dataset.<br>• Implement big data analytics using Hadoop and Apache Spark.<br>• Create insightful visualizations and perform statistical analysis using advanced tools.<br>• Develop and implement advanced machine learning models on a complex dataset.<br>• Significance of activation function like linear,tanh ,Relu<br>• Dimensionality reduction for data analysis- E.g.: Principal Component Analysis | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | 1 | - | 1 | 2 | | | | | | |
| CO 2 | 2 | 2 | 2 | 1 | 2 | 3 | | | | | | |
| CO 3 | 2 | 2 | 1 | 1 | 2 | 3 | | | | | | |
| CO 4 | 2 | 1 | 1 | 1 | 2 | 2 | | | | | | |
| CO 5 | 2 | 3 | 3 | 3 | 3 | 3 | | | | | | |
| CO6 | 2 | - | 1 | - | 2 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | | | ✓ | |
| CO6 | | | ✓ | |

**References:**

1. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.

2. David Dietrich, "EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, 2015.

3. Jaiwei Han, MichelineKamber, "Data Mining Concepts and Techniques", Elsevier, 2006.

4. Christian Heumann and Michael Schomaker, "Introduction to Statistics and DataAnalysis", Springer, 2016

5. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics. Pearson, 2012.

6. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

## BCA5EJ302(4) - Knowledge Engineering

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5EJ302(4) | | | | |
| Course Title | Knowledge Engineering | | | | |
| Type of Course | Elective | | | | |
| Semester | V | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |

| | |
|---|---|
| Pre-requisites | 1. Understanding of basic mathematics and statistics<br>2. Basic understanding of computer science concepts |
| Course Summary | This course introduces students to the principles, techniques, and tools used in Knowledge Engineering. It covers the design and development of knowledge-based systems, including knowledge representation, reasoning, and acquisition. |

**Course Outcomes (CO): .**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand basics of Knowledge Engineering | U | C | Instructor-created exams / Quiz |
| CO2 | Apply methodologies and modelling for agent design and development | Ap | P | Assignment / Seminar presentations/ Exams |
| CO3 | Design and develop ontologies | Ap | P | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Apply reasoning with ontologies and rules | Ap | P | Instructor-created exams / Home Assignments |
| CO5 | Understand learning and rule learning | U | C | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Develop theoretical knowledge to design a knowledge-based system | Ap | P | Case Study/ Group discussions/ Presentations |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Reasoning under uncertainity** | | **15** | **15** |
| | 1 | Understanding the World through Evidence-based Reasoning: - Evidence, Data, and Information, Evidence and Fact, Evidence and Knowledge | 2 | |
| | 2 | Abductive Reasoning | 1 | |
| | 3 | Probabilistic Reasoning: - Enumerative Probabilities: Obtained by Counting, Subjective Bayesian View of Probability | 2 | |
| | 4 | Belief Functions | 1 | |
| | 5 | Baconian Probability, Fuzzy Probability | 3 | |
| | 6 | Evidence-based Reasoning | 2 | |
| | 7 | Artificial Intelligence: - Intelligent Agents, Mixed-Initiative Reasoning | 2 | |
| | 8 | Knowledge Engineering: - An Ontology of Problem-Solving Tasks, Building Knowledge-based Agents | 2 | |
| **II** | **Methodologies and Tools for Agent Design and Development, Modelling the Problem-Solving Process** | | **12** | **20** |

| | | | | |
|---|---|---|---|---|
| | 9 | A Conventional Design and Development Scenario | 2 | |
| | 10 | Development Tools and Reusable Ontologies | 2 | |
| | 11 | Agent Design and Development Using Learning Technology | 2 | |
| | 12 | Problem Solving through Analysis and Synthesis | 1 | |
| | 13 | Inquiry-driven Analysis and Synthesis for Evidence-based Reasoning | 2 | |
| | 14 | Evidence-based Assessment, Believability Assessment | 3 | |
| **III** | **Ontologies** | | **11** | **20** |
| | 15 | What Is an Ontology? Concepts and Instances, Generalization Hierarchies | 2 | |
| | 16 | Object Features, Defining Features, Defining Features, Representation of N-ary Features | 2 | |
| | 17 | Transitivity, Inheritance, Ontology Matching | 3 | |
| | 18 | Ontology Design and Development Methodology- Steps in Ontology Development, Domain Understanding and Concept Elicitation, Modeling-based Ontology Specification | 4 | |
| **IV** | **Reasoning with Ontologies and Rules** | | **10** | **15** |
| | 19 | Production System Architecture | 1 | |
| | 20 | Complex Ontology-based Concepts | 1 | |
| | 21 | Reduction and Synthesis Rules and the Inference Engine, Evidence-based Hypotheses Analysis, Rule for Ontology Matching | 4 | |
| | 22 | Partially Learned Knowledge, Reasoning with Partially Learned Knowledge | 4 | |
| **V** | **Open Ended Module- Learning for Knowledge-based Agents** | | **12** | |
| | 1 | Generalization and Specialization Rules | 4 | |
| | 2 | Types of Generalizations and Specializations | 4 | |
| | 3 | Analogy-based Generalization | 4 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 1 | - | - | 1 | 1 | | | | | | |
| CO 2 | 1 | - | - | - | 1 | 1 | | | | | | |
| CO 3 | 1 | 3 | 1 | 1 | 2 | 3 | | | | | | |
| CO 4 | 1 | - | 1 | 1 | 2 | 3 | | | | | | |
| CO 5 | 1 | - | - | - | 2 | 3 | | | | | | |
| CO 6 | 1 | 2 | 1 | 1 | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | |

**References:**

1. “Knowledge Engineering”, Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum.
2. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
3. "Knowledge Representation and Reasoning" by Ronald J. Brachman and Hector J. Levesque.

## BCA6EJ303(4) - Advanced Python for Data Science

| | |
|---|---|
| Programme | BCA |
| Course Code | BCA6EJ303(4) |
| Course Title | Advanced Python for Data Science |
| Type of Course | Elective |
| Semester | VI |
| Academic Level | 300 - 399 |

| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
|---|---|---|---|---|---|
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Data Science Concepts<br>2. Python basics | | | | |
| Course Summary | This course provides insight into the basic concepts of Python required for Data Science. It includes array fundamentals, array transformations, and matrices fundamentals. The analysis of data using Pandas will help the students to understand the basics of data analysis | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the concepts of arrays, matrices and their transformations | U | C | Instructor-created exams / Quiz |
| CO2 | Create informative plots using Python packages | Ap | P | Modelling Assignments/ Case Studies |
| CO3 | Understand the loading mechanism of different types of data and manipulate them | U | C | Instructor-created exams / Quiz |
| CO4 | Analyse the data using Pandas and Data Frames | An | P | Modelling Assignments/ Case Studies |
| CO5 | Understand the concepts of random tensors and generate tensors from various distributions | U | C | Instructor-created exams / Quiz |
| CO6 | Familiarize with various TensorFlow operations needed for Data Science | U | C | Instructor-created exams / Quiz |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Arrays, Matrix manipulation using NumPy** | | **10** | **12** |
| | 1 | Array creation, sorting, concatenating | 2 | |
| | 2 | Shape and size of an array, basic arithmetic operations on an array, broadcasting | 2 | |
| | 3 | Aggregate functions on arrays, Unique and count operations | 2 | |
| | 4 | Matrices using NumPy | 2 | |
| | 5 | Transpose, reverse, flatten and ravel | 2 | |
| **II** | **Data Analysis and Manipulation using Pandas** | | **12** | **18** |
| | 6 | Series - constructing from an array, using explicitly defined indices, using a dictionary. | 2 | |
| | 7 | Data Frame - constructing from arrays, dictionaries, structured arrays, and series, Indexing of data frames | 3 | |

| | | | | |
|---|---|---|---|---|
| | 8 | Arithmetic and Binary operations on Data frame | 3 | |
| | 9 | Broadcasting operations | 2 | |
| | 10 | Universal functions, melt() and pivot() | 2 | |
| **III** | **Other Python packages for data science** | | **10** | **14** |
| | 11 | Scipy, Scikit-learn, PyTorch, Seaborn, Scrapy, and Beautiful Soup. | 3 | |
| | 12 | Python Data Operations: Importing and Exporting Data, Data Cleansing | 3 | |
| | 13 | Processing CSV Data, Processing JSON Data, Processing XLS Data. | 2 | |
| | 14 | Data Analysis: Measuring Central Tendency, Measuring Variance, and Correlation in Python | 2 | |
| **IV** | **TensorFlow Fundamentals** | | **16** | **26** |
| | 15 | Tensors, creation of tensors and random tensors, Tensors from the Normal distribution, Poisson distribution, set_seed() | 2 | |
| | 16 | Tensor attributes, size, rank and reshaping of a tensor | 2 | |
| | 17 | Tensor arithmetic, relational, logical operations. Shuffle() | 2 | |
| | 18 | Reduce operations on tensor Dimension-wise | 2 | |
| | 19 | Ragged tensors, TensorArray, dynamic arrays, | 2 | |
| | 20 | unique(), fill(), concat(), gather(), ones(), ones_like(), zeros(), | 2 | |
| | 21 | eye(), range(), repeat, reverse(), roll(), slice(), sort(), | 2 | |
| | 22 | split(), squeeze(), tile(), stack(), unstack(), tensordot() | 2 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | Use Pandas and NumPy to efficiently process and analyze CSV, Excel, or JSON data | 4 | |
| | 2 | Create compelling visual insights using Matplotlib, Seaborn, or Plotly | 3 | |
| | 3 | Case studies with Tensor flow | 5 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | - | - | 2 | 2 | 2 | | | | | | |
| CO 2 | 2 | 1 | - | - | 2 | 2 | | | | | | |
| CO 3 | 1 | - | 2 | - | 2 | 2 | | | | | | |
| CO 4 | 1 | 1 | 1 | 2 | 2 | 2 | | | | | | |
| CO 5 | 2 | - | - | - | 2 | 2 | | | | | | |
| CO 6 | - | - | 2 | 2 | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | ✓ | ✓ | ✓ |
| CO 3 | ✓ | | ✓ | ✓ |
| CO 4 | ✓ | ✓ | ✓ | ✓ |
| CO 5 | ✓ | | | ✓ |
| CO 6 | ✓ | | | ✓ |

**References:**

1. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. United States, O'Reilly Media, 2016.
2. Rogel-Salazar, Jesus. Data Science and Analytics with Python. United Kingdom, CRC Press, 2018.
3. https://numpy.org/doc/
4. https://pandas.pydata.org/docs/
5. https://www.tensorflow.org/guide

## BCA6EJ304(4) - Neural Networks and Deep Learning

| | |
|---|---|
| Programme | BCA |
| Course Code | BCA6EJ304(4) |
| Course Title | Neural Networks and Deep Learning |
| Type of Course | Elective |
| Semester | VI |

| | | | | | |
|---|---|---|---|---|---|
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Mathematical Foundation for CS<br>2. Machine Learning | | | | |
| Course Summary | Explores core principles and advanced methodologies in neural networks and deep learning, spanning from foundational concepts like perceptrons to specialized architectures such as CNNs and RNNs. Students will gain comprehensive knowledge of neural network design, training, and optimization, equipping them to tackle various theoretical and computational challenges within these frameworks. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Illustrate the basic concepts of neural networks and its practical applications | Ap | P | Practical Assignment / Instructor created exams / Quiz |
| CO2 | Implementing basic concept of neural networks | Ap | P | Practical Assignment / Instructor created exams / Quiz |
| CO3 | Applying the optimization technique in neural networks | Ap | P | Practical Assignment / Instructor created exams / Quiz |
| CO4 | Implement the foundation layer of CNN | Ap | P | Practical Assignment / Instructor created exams / Quiz |
| CO5 | Implement a sequence model using recurrent neural network | Ap | P | Practical Assignment / Instructor- created exams / Quiz |
| CO6 | Explore the application area of deep learning like NLP, Voice Recognition, Speech Recognition | Ap | P | Practical Assignment / Instructor created exams / Quiz |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Neural Networks and Deep Learning** | | **10** | **15** |
| | 1 | Introduction to neural networks -Single layer perceptrons, Multi-Layer Perceptrons (MLPs) | 1 | |
| | 2 | Representation Power of MLPs, Activation functions - Sigmoid, Tanh, ReLU, Softmax | 3 | |
| | 3 | Risk minimization, Loss function, Training MLPs with backpropagation | 3 | |
| | 4 | The Problem of Overfitting, Vanishing and exploding gradient problems | 3 | |
| **II** | **Deep Learning and optimization technique** | | **12** | **15** |
| | 5 | Introduction to deep learning, Deep feed forward network | 3 | |
| | 6 | Training deep models. Eigen value, Eigen vector concepts. | 3 | |
| | 7 | Optimization techniques - Gradient Descent (GD), GD with momentum, Nesterov accelerated GD, Stochastic GD | 2 | |
| | 8 | Regularization Techniques - L1 and L2 regularization, Early stopping | 2 | |
| | 9 | Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods. | 2 | |
| **III** | **Convolution Neural Networks** | | **13** | **20** |
| | 10 | Convolution operation, Motivation | 1 | |
| | 11 | Pooling, Convolution and Pooling as an infinitely strong prior | 3 | |
| | 12 | Variants of convolution functions | 2 | |
| | 13 | Structured outputs | 2 | |
| | 14 | Data types | 1 | |
| | 15 | Efficient convolution algorithms | 3 | |

| | | | | |
|---|---|---|---|---|
| **IV** | **Recurrent Neural Networks** | | **13** | **20** |
| | 16 | Computational graphs | 1 | |
| | 17 | RNN design | 1 | |
| | 18 | Encoder – decoder sequence to sequence architectures | 2 | |
| | 19 | Deep recurrent networks | 2 | |
| | 20 | Recursive neural networks | 3 | |
| | 21 | Modern RNNs LSTM and GRU. | 2 | |
| | 22 | Practical use cases for RNNs. | 2 | |
| **V** | **Open Ended Module – Applications** | | **12** | |
| | 1 | Implement the tasks from the following:<br>• Implement and analyze single-layer and multi-layer perceptrons with activation functions, loss functions, and backpropagation.<br>• Investigate overfitting, vanishing gradients, and exploding gradients in deep networks, and explore solutions.<br>• Design and train a CNN for image classification, focusing on convolution, pooling, and efficient algorithms.<br>• Implement and train RNNs, including LSTM and GRU, for sequence prediction, and analyze their performance.<br>• Train a deep feed-forward network on a complex dataset, using eigenvalues and eigenvectors, and compare optimization techniques. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 2 | 2 | 2 | 1 | | | | | | |
| CO 2 | 2 | 1 | 3 | 2 | 2 | 2 | | | | | | |
| CO 3 | 3 | 1 | 3 | 2 | 3 | 2 | | | | | | |
| CO 4 | 3 | 2 | 3 | 3 | 3 | 3 | | | | | | |
| CO 5 | 3 | 2 | 3 | 3 | 3 | 3 | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

2. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018

3. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). Nikhil Buduma and Nicholas Locascio. 2017. O'Reilly Media, Inc.

# Basket of No Specialization Electives (for VII, VIII Semesters)

## BCA7EJ401(1) - Theory of Computation

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7EJ401(1) | | | | |
| Course Title | Theory of Computation | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Understanding of basic mathematical concepts such as sets, functions, relations, logic and discrete structures.<br>2. Understanding of fundamental programming constructs such as loops, conditionals, functions, and recursion. | | | | |
| Course Summary | This course covers a comprehensive exploration of fundamental concepts in computer science, delving into computational models, formal language theory, and computational complexity. Students learn about various computational models such as finite automata, pushdown automata, and Turing machines, gaining insights into their capabilities and limitations. Through the study of formal languages and grammars, students understand the structure and properties of regular and context-free languages. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To learn and understand fundamental concepts in computational theory, including computational models such as finite automata, pushdown automata, and Turing machines. | U | P | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | To be able to classify formal language into regular, context-free, context sensitive and unrestricted languages. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | To design and analyse Turing machines, their capabilities and limitations | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Construct the abstract machines including finite automata, pushdown automata, and Turing machines from their associated languages and grammar | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Gain insights into decidability and undecidability, and understand the | Ap | P | Practical Assignment / |

| | | | | |
|---|---|---|---|---|
| | limitations of computation through the study of the halting problem and other undecidable problems. | | | Instructor-created exams / Quiz |
| CO6 | Solve computational problems regarding their computability and complexity and prove the basic results of the theory of computation | E | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| I | | **FINITE AUTOMATA** | **10** | **16** |
| | 1 | Formal Language: Definition, Chomsky classification of Grammar, Language and Relation, Language and Automata | 2 | |
| | 2 | Finite Automata: DFA, NFA with and without €- moves | 2 | |
| | 3 | Equivalence of DFA and NFA | 2 | |
| | 4 | Equivalence of NFA and €-NFA | 2 | |
| | 5 | Mealy and Moore Models - Conversions | 2 | |
| II | | **REGULAR LANGUAGE, REGULAR EXPRESSION** | **10** | **18** |
| | 6 | Regular Languages: Regular Expressions, Ardens Theorm | 2 | |
| | 7 | Conversion of Regular Expression to Finite Automata | 2 | |
| | 8 | Closure properties of RLs | 2 | |
| | 9 | Pumping lemma for RLs | 2 | |
| | 10 | Myhill-Nerode theorem | 2 | |
| III | | **PUSH DOWN AUTOMATA, CONTEXT FREE LANGUAGE** | **14** | **18** |
| | 11 | Pushdown Automata - Instantaneous Description - Transition Diagram | 3 | |
| | 12 | Deterministic and Non Deterministic PDA | 3 | |
| | 13 | Equivalence of PDAs and CFGs, Pumping lemma for CFLs | 2 | |
| | 14 | Closure properties of CFLs, Simplification of CFLs | 2 | |
| | 15 | Chomsky Normal form (CNF) and Greibach Normal form (GNF) | 2 | |
| | 16 | CYK algorithm for CFL membership | 2 | |
| IV | | **TURING MACHINE, UNDECIDABILITY** | **14** | **18** |
| | 17 | Turing Machine - Instantaneous Description - Transition Diagram | 3 | |
| | 18 | Variants of TMs - Equivalence of the various variants with basic model | 3 | |
| | 19 | Recursively Enumerable and Recursive languages | 2 | |
| | 20 | Church Turing hypothesis - Rices theorem | 2 | |
| | 21 | Undecidability of Posts correspondence problem | 2 | |
| | 22 | The Class P and NP | 2 | |
| V | | **Open Ended Module- Application Level** | **12** | |
| | | 1. Application of regular expressions in pattern matching and text processing.<br>2. Analysis of context-free languages using pumping lemma | | |

| | | | | |
|---|---|---|---|---|
| | | and closure properties.<br>3. Investigation of undecidability and un-solvability using the halting problem and Rice's theorem.<br>4. Notion of tractability: The Class P and NP, NP completeness of propositional satisfiability, other variants of satisfiability. NP-complete problems from other domains: graphs (clique, vertex cover, independent sets, Hamiltonian cycle), number problem (partition), set cover.<br>5. Discussion of practical implications and applications of complexity theory. | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | 2 | 1 | - | - | | | | | | |
| CO 2 | 1 | 1 | 2 | 1 | - | - | | | | | | |
| CO 3 | - | 3 | 1 | 1 | - | - | | | | | | |
| CO 4 | - | 3 | 3 | 2 | - | - | | | | | | |
| CO 5 | - | 1 | 3 | 3 | 1 | - | | | | | | |
| CO 6 | - | 1 | 3 | 3 | 1 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**Reference:**

1. J.E. Hopcroft, R. Motwani and J.D Ullman, ―Introduction to Automata Theory, Languages and Computations, Third Edition, Pearson Education, 2016.
2. Theory of Computer Science- Automata, Languages and Computation- K.L.P. Mishra, N Chandrasekaran, PHI
3. Theory of Computation, Sachin Agrawal, Vikas Publishing House
4. Micheal Sipser, ―Introduction of the Theory and Computation, Thomson Brokecole, 3rd Edition, 2013.
5. J. Martin, ―Introduction to Languages and the Theory of Computation, Third Edition, TMH, 2007.
6. An Introduction to Formal languages and Automata- Peter Linz.

## BCA7EJ401(2) - Expert Systems and Fuzzy Logic

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7EJ401(2) | | | | |
| Course Title | Expert Systems and Fuzzy Logic | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Familiarity with basic logic and set theories.<br>2. Understanding the fundamentals of computer science, such as algorithms and data structures, can be beneficial for the implementation aspects of expert systems.<br>3. A basic understanding of probability and statistics is often required. | | | | |
| Course Summary | The Fuzzy logic and expert systems course introduce two interconnected fields in artificial intelligence: fuzzy logic and expert systems. Fuzzy logic deals with reasoning under uncertainty and imprecision, while expert systems involve the development of computer-based systems that emulate human expertise in specific domains. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Explain the fundamental concepts of fuzzy set theory and interpret membership functions and linguistic variables. | U | F | Instructor-created exams / Quiz |
| CO2 | Design and implement fuzzy controllers for decision-making. Develop fuzzy inference systems (FIS) for various applications and apply fuzzy clustering techniques for pattern recognition. | U | C | Practical Assignment / Observation of Practical Skills |
| CO3 | Describe the role of expert systems in artificial intelligence and Understand knowledge representation techniques in expert systems. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO4 | Explain the functioning of inference engines in rule-based systems. | Ap | P | Practical Assignment / Observation of Practical Skills |
| CO5 | Acquire domain knowledge for expert system development. | An | C | Instructor-created exams / Quiz |
| CO6 | Construct a knowledge base and define rules for an expert system and implement validation and refinement techniques for expert systems. | Ap | P | Practical Assignment / Observation of Practical Skills |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| **I** | **Introduction to Fuzzy Logic** | | **8** | **10** |
| | 1 | Overview of Fuzzy Logic | 1 | |
| | 2 | Fuzzy Sets and Membership Functions | 2 | |
| | 3 | Fuzzy Operations (Union, Intersection, Complement) | 2 | |
| | 4 | Basic principles of fuzzy logic.<br>Fuzzification and defuzzification. | 2 | |
| | 5 | Linguistic variables and terms. | 1 | |
| **II** | **Fuzzy Inference Systems (FIS) and Fuzzy Logic Applications** | | **12** | **20** |
| | 6 | Mamdani FIS-Rule-based systems in fuzzy logic, Rule base and implication methods. | 2 | |
| | 7 | Sugeno FIS-Structure and operation of Sugeno FIS.<br>Comparison with Mamdani FIS. | 2 | |
| | 8 | Basic structure of fuzzy logic controllers (FLCs) | 3 | |

| | | | | |
|---|---|---|---|---|
| | 9 | Rule-based systems and fuzzy inference | 3 | |
| | 10 | Applications of fuzzy logic controllers | 2 | |
| **III** | **Introduction to Expert Systems and Rule-Based Systems** | | **12** | **20** |
| | 11 | Definition and characteristics of expert systems. | 2 | |
| | 12 | Knowledge representation and reasoning. | 3 | |
| | 13 | Expert system components: knowledge base, inference engine, user interface. Examples and applications of expert systems | 3 | |
| | 14 | Rule-based systems and production rules, Forward and backward chaining. | 2 | |
| | 15 | Inference mechanisms in expert systems, Examples of rule-based expert systems. | 2 | |
| **IV** | **Introduction to SCILAB/MATLAB Programming** | | **16** | **20** |
| | 16 | SCILAB/MATLAB environment and basic navigation, Variables, data types, and basic operations, Script files and running SCILAB/MATLAB code. Introduction to functions and function files. | 3 | |
| | 17 | Introduction to functions and function files, Conditional statements (if, else, elseif), Loop structures (for, while). | 2 | |
| | 18 | Logical operators and relational expressions, Vectorized operations and element-wise operations. | 2 | |
| | 19 | Introduction to arrays, matrices, and vectors, Cell arrays and structures, Indexing and slicing in SCILAB/MATLAB, Working with multidimensional arrays. | 2 | |
| | 20 | Basic file input/output operations, Reading and writing data files (text, CSV, Excel), Data visualization using plotting functions. | 2 | |
| | 21 | Statistical analysis and plotting techniques, Fuzzy logic toolbox in SCILAB/MATLAB. | 2 | |
| | 22 | Expert system development tools in SCILAB/MATLAB, Building expert systems using SCILAB/MATLAB. | 3 | |
| **V** | **Lab Activities** | | **12** | |
| | | Implement the tasks from the following:<br><br>**Fuzzy logic using SCILAB/MATLAB**<br>1. Membership Functions:<br>• Define triangular and trapezoidal membership functions for a variable representing temperature. Plot these membership functions.<br>• Write SCILAB/MATLAB code to calculate the membership values for a given temperature.<br>2. Fuzzy Logic Operations:<br>• Implement the operations AND, OR, and NOT using fuzzy logic.<br>• Use SCILAB/MATLAB to perform fuzzy logic operations on two fuzzy sets representing temperature and humidity.<br>3. Rule-Based System:<br>• Create a simple fuzzy rule-based system for a temperature control system. Define rules based on temperature and humidity inputs.<br>• Implement the rule-based system using SCILAB/MATLAB and simulate different input scenarios.<br>4. Fuzzy Inference:<br>• Implement Mamdani and Sugeno fuzzy inference systems for a traffic light control system. | 6 | |

| | | | | |
|---|---|---|---|---|
| | | • Evaluate the systems with different input values and compare their outputs. | 6 | |
| | | Implement the tasks from the following:<br><br>**Expert System using SCILAB/MATLAB**<br>1. Rule-Based System Initialization:<br>• Define a knowledge base for a diagnostic expert system. Include rules that link symptoms to possible diseases.<br>• Implement the rule-based system in SCILAB/MATLAB using if-else statements or switch-case constructs.<br>2. Rule Inference Engine:<br>• Develop a rule inference engine that evaluates the rules in the knowledge base based on user input.<br>Use SCILAB/MATLAB functions to implement rule-based inference and determine the likely diagnosis for a set of symptoms. | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | - | - | - | 1 | | | | | | |
| CO 2 | 1 | 3 | - | - | 1 | - | | | | | | |
| CO 3 | 1 | 3 | - | - | 2 | 2 | | | | | | |
| CO 4 | 1 | 3 | - | - | 2 | 2 | | | | | | |
| CO 5 | 2 | 1 | 3 | 1 | 1 | - | | | | | | |
| CO 6 | 2 | 1 | 3 | 2 | 2 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | ✓ | ✓ |
| CO 3 | ✓ | ✓ | ✓ | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |
| CO 5 | | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | ✓ | ✓ |

**References:**


1. "Fuzzy Logic with Engineering Applications" by Timothy J. Ross
2. "Expert Systems: Principles and Programming" by Joseph C. Giarratano and Gary D. Riley
3. "Fuzzy Sets and Fuzzy Logic: Theory and Applications" by George J. Klir and Bo Yuan
4. "Expert Systems: Principles and Case Studies" by Efraim Turban, Jay E. Aronson, and Ting-Peng Liang
5. “Introduction to Fuzzy Logic using MATLAB” by S.N. Sivanandam, S. Sumathi, and S. N. Deepa.
6. Nagar, S. (2017). Introduction to Scilab: For Engineers and Scientists. Apress.
7. Sheth, T. (2016). Scilab: A Practical Introduction to Programming and Problem Solving. CreateSpace Independent Publishing Platform.
8. Gomez, C. (1999). Engineering and Scientific Computing with Scilab. Birkhäuser.


## BCA7EJ401(3) - Modern Cryptography

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7EJ401(3) | | | | |
| Course Title | Modern Cryptography | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basic understanding of computer networks | | | | |
| Course Summary | This course covers the essential concepts of computer security, including various security threats and attacks, as well as different cryptographic algorithms aimed at preserving confidentiality, integrity, and ensuring message authentication | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understanding the fundamentals of cryptography | U | C | Instructor-created exams / Quiz |
| CO2 | Acquire a basic knowledge about the security threats and different types of attacks | U | C | Instructor-created exams / Quiz |
| CO3 | Get a basic idea about traditional ciphers | U | C | Instructor-created exams / Home assignments |
| CO4 | Familiarize the standard symmetric key algorithms | A | P | Instructor-created exams / Home assignments |
| CO5 | Familiarize the concepts of public key cryptography | A | P | Instructor-created exams / Home assignments |
| CO6 | Interpret data integrity, authentication, and digital signature | A | P | Instructor-created exams / Home assignments |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Computer and Network Security** | | **9** | **15** |
| | 1 | Computer Security Concepts – CIA triad, challenges of computer security | 1 | |
| | 2 | The OSI security architecture – Security attacks, mechanism and services | 3 | |
| | 3 | Fundamental security design principles | 1 | |
| | 4 | Attack surfaces and attack trees | 2 | |
| | 5 | A model for Network security and standards | 2 | |
| **II** | **Symmetric Key Cryptography** | | **15** | **15** |
| | 6 | Symmetric Cipher model | 3 | |
| | 7 | Substitution and Transposition techniques | 3 | |
| | 8 | Traditional block cipher structure | 2 | |
| | 9 | Data Encryption standard- Algorithm, example, strength | 3 | |
| | 10 | Advanced Encryption standard- structure, Transformation function, example | 3 | |
| | 11 | Key channel establishment for symmetric cryptosystems | 1 | |
| **III** | **Public Key Cryptography** | | **10** | **20** |
| | 12 | Principles of Public key crypto systems- public key crypto | 4 | |

| | | | | |
|---|---|---|---|---|
| | | systems, applications, requirements | | |
| | 13 | RSA algorithm | 2 | |
| | 14 | Security of RSA algorithm | 2 | |
| | 15 | Diffie-Hellman key exchange | 2 | |
| **IV** | **Cryptographic Data Integrity Algorithms** | | **14** | **20** |
| | 16 | Cryptographic hash functions- applications | 2 | |
| | 17 | Message Digest algorithm | 2 | |
| | 18 | Secure Hash Algorithm | 2 | |
| | 19 | Message Authentication Code -requirements, security | 2 | |
| | 20 | MACs based on Hash Functions | 2 | |
| | 21 | Digital Signature – properties, attacks and forgeries, requirements | 2 | |
| | 22 | RSA-PSS digital signature algorithm | 2 | |
| **V** | **Open Ended Module** | | **12** | |
| | 1 | Email, IP and web security | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | - | - | 2 | - | | | | | | |
| CO 2 | 3 | 2 | - | - | - | - | | | | | | |
| CO 3 | 1 | 2 | - | - | - | - | | | | | | |
| CO 4 | 1 | 3 | 1 | 2 | - | - | | | | | | |
| CO 5 | 1 | 3 | 1 | 2 | - | - | | | | | | |
| CO 6 | 3 | 2 | 1 | 1 | 1 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | ✓ |
| CO 4 | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | ✓ |

**References:**


1. "Cryptography and Network Security- Principles and Practice", William Stallings.
2. "Modern Cryptography: Theory and Practice"- Wenbo Mao Hewlett-Packard Company.
3. Cryptography and Information Security"- V K Pachghare.


## BCA7EJ402(1) - Client Server Architecture

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7EJ402(1) | | | | |
| Course Title | Client Server Architecture | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Knowledge in Fundamentals of Network and Operating System | | | | |
| Course Summary | The syllabus is prepared with the view of preparing the Bachelor of Computer Application Graduates to build effective Client/Server applications. This course aims at providing a foundation in decentralized computer systems, using the client/server model. The course content is decided to cover the essential fundamentals which can be taught within the given slots in the curriculum. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the basics of client/server systems and the driving force | U | C | Instructor-created exams / Quiz |

| | | | | |
|---|---|---|---|---|
| | behind the development of client/server systems. | | | |
| CO2 | Outline the architecture and classifications of client/server systems | U | C | Instructor-created exams / Quiz |
| CO3 | Choose the appropriate client/server network services for a typical application | U | P | Instructor-created exams / Quiz |
| CO4 | Describe management services | U | C | Instructor-created exams / Case studies |
| CO5 | Describe issues in network | U | P | Instructor-created exams / Quiz Case studies |
| CO6 | Apply various services and support | U | P | Instructor-created exams / Quiz /Case studies |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

## Detailed Syllabus

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Client/Server computing** | | **12** | **15** |
| | 1 | Introduction to Client/Server computing - Driving forces behind Client/ Server, Client/ Server development tools | 2 | |
| | 2 | Development of client/server systems, Client/Server security | 2 | |
| | 3 | Organizational Expectations, Improving performance of client/server applications | 2 | |
| | 4 | Single system image, Downsizing and Rightsizing | 3 | |
| | 5 | Advantages of client server computing, Applications of Client/Server | 3 | |
| **II** | **Client/Server Application Components** | | **12** | **15** |
| | 6 | Classification of Client/Server Systems- Two-Tier Computing, Middleware, Three-Tier Computing | 2 | |
| | 7 | Model View Controller (MVC) | 1 | |
| | 8 | Principles behind Client/Server Systems | 3 | |
| | 9 | Client/Server Topologies | 3 | |
| | 10 | Existing Client/Server Architecture. | 1 | |
| | 11 | Architecture for Business Information System | 2 | |
| **III** | **Client/ Server Systems Development** | | **12** | **20** |
| | 12 | Client- Services, Request for services, RPC, Windows services, Print services, Remote boot services, other remote services, Utility Services. | 2 | |
| | 13 | Dynamic Data Exchange (DDE). | 2 | |
| | 14 | Object Linking and Embedding (OLE). | 2 | |
| | 15 | Common Object Request Broker Architecture (CORBA). | 2 | |
| | 16 | Server- Detailed server functionality | 2 | |
| | 17 | Network operating system, Available platforms, Server operating system. | 2 | |
| **IV** | **Client/ Server Systems Development** | | **12** | **20** |
| | 18 | Services and Support- System administration, Availability, Reliability, Scalability, Observability, Agility, Serviceability. | 2 | |
| | 19 | Software Distribution, Performance, Network management. | 2 | |
| | 20 | Remote Systems Management- RDP, Telnet, SSH, Security. | 3 | |
| | 21 | LAN and Network Management issues, Training, Connectivity | 2 | |
| | 22 | Communication interface technology, Inter process communication | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | **CASE STUDY: Client Server Architecture**<br>Generic Client/Server Classes<br>Client/Server Communication via Sockets<br>The Server Protocol<br>The Client Protocol<br>A Two-Way Stream Connection | | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | 2 | - | - | - | - | | | | | | |
| CO2 | - | 3 | - | - | - | - | | | | | | |
| CO3 | - | 2 | 1 | - | - | - | | | | | | |
| CO4 | 1 | 2 | 1 | 1 | 1 | 1 | | | | | | |
| CO5 | - | 2 | 1 | - | - | - | | | | | | |
| CO6 | 1 | 2 | 1 | - | 1 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**Reference:**

1. Patrick Smith & Steave Guengerich, “Client / Server Computing”, PHI.
2. Dawna Travis Dewire, “Client/Server Computing”, TMH.
3. Jeffrey D.Schank, “Novell’s Guide to Client-Server Application & Architecture” Novell Press.
4. Robert Orfali, Dan Harkey, Jeri Edwards, Client/Server Survival Guide, Wiley- India.

# BCA7EJ402(2) - Blockchain Technology

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7EJ402(2) | | | | |
| Course Title | Blockchain Technology | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | TotalHours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Strong programming skills in at least one popular language, such as Java or Python. Knowledge of cryptography and data structures (like linked lists and arrays). Good understanding of networking concepts | | | | |
| Course Summary | The syllabus is prepared with the view of preparing the Bachelor of Computer Application Graduates to create awareness and understanding among students on the foundation of blockchain technology. The course introduces the cryptographic principles behind blockchain and helps the students understand concepts like consensus, crypto-currency, smart contracts, use cases etc. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the basics of cryptographic building blocks in blockchain technology. | U | C | Instructor-created exams / Quiz |
| CO2 | Explain the fundamental concepts of blockchain technology. | U | C | Instructor-created exams / Quiz |
| CO3 | Summarize the classification of consensus algorithms | U | P | Instructor-created exams / Quiz |
| CO4 | Explain the concepts of first decentralized cryptocurrency bitcoin | U | C | Instructor-created exams / Case studies |
| CO5 | Describe the use of smart contracts and its use cases | U | P | Instructor-created exams / Quiz Case studies |
| CO6 | Develop simple block chain applications | U | P | Instructor-created exams / Quiz /Case studies |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | | **Fundamentals of Cryptography** | **12** | **15** |
| | 1 | Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric cryptography –RSA. Elliptic curve cryptography, | 3 | |
| | 2 | Digital signatures – RSA digital signature algorithms. | 2 | |
| | 3 | Secure Hash Algorithms – SHA-256. | 2 | |
| | 4 | Applications of cryptographic hash functions – Merkle trees | 3 | |
| | 5 | Distributed hash tables | 2 | |
| **II** | | **Fundamentals of Blockchain Technology** | **12** | **15** |
| | 6 | Blockchain – Definition, architecture, elements of blockchain, benefits and limitations. | 2 | |
| | 7 | Types of blockchain | 1 | |
| | 8 | Consensus – definition, types, consensus in blockchain, | 3 | |
| | 9 | Decentralization – Decentralization using blockchain | 3 | |
| | 10 | Methods of decentralization, Routes to decentralization, | 1 | |
| | 11 | Blockchain and full ecosystem decentralization | 2 | |
| **III** | | **Consensus Algorithms and Bitcoin** | **12** | **20** |
| | 12 | Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT),. | 2 | |
| | 13 | Proof of work (PoW), Proof of stake (PoS), Types of PoS | 2 | |
| | 14 | Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses | 2 | |
| | 15 | Transactions –Lifecycle, Coinbase transactions, transaction validation Blockchain – The genesis block. | 2 | |
| | 16 | Mining – Tasks of miners, mining algorithm, hash rate | 2 | |
| | 17 | Wallets – Types of wallets. | 2 | |
| **IV** | | **Smart Contracts and Use cases** | **12** | **20** |
| | 18 | Smart Contracts – Definition, Smart contract templates, Deploying smart contracts | 2 | |
| | 19 | Oracles, Types of oracles. | 2 | |
| | 20 | Decentralization terminology – Decentralized applications, Decentralized Autonomous Organizations | 3 | |
| | 21 | Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management. | 2 | |
| | 22 | Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence | 3 | |
| **V** | | **Open Ended Module** | **12** | |
| | | **CASE STUDY: BLOCKCHAIN TECHNOLOGY**<br>Solidity language<br>Ethereum platform | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | 2 | - | - | - | - | | | | | | |
| CO2 | - | 2 | - | - | - | - | | | | | | |
| CO3 | 1 | 2 | 3 | 3 | - | - | | | | | | |
| CO4 | - | 2 | 3 | 3 | 1 | 1 | | | | | | |
| CO5 | - | 1 | 1 | - | 2 | 3 | | | | | | |
| CO6 | 2 | 1 | 1 | - | 2 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**Reference Books:**

1.Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, Packt Publishing, Third edition, 2020.

2. Ritesh Modi, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain, Packt Publishing, First edition, 2018.

3. Kumar Saurabh, Ashutosh Saxena, Blockchain Technology: Concepts and Applications, First Edition, Wiley Publications, First edition, 2020.

4. Chandramouli Subramanian, Asha A George, et al, Blockchain Technology, Universities Press (India) Pvt. Ltd, First edition, August 2020

5. Lorne Lantz, Daniel Cawrey, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'Reilly Media, First edition, 2020.

**6.** Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, First edition, 2018**.**

## BCA7EJ402(3) - Data Mining

| | |
|---|---|
| Programme | BCA |
| Course Code | BCA7EJ402(3) |
| Course Title | Data Mining |

| | | | | | |
|---|---|---|---|---|---|
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Basics of statistics | | | | |
| Course Summary | This course provides an introduction to the principles, techniques, and applications of data mining. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the fundamental concepts and principles of data mining. | U | C | Instructor-created exams / Quiz |
| CO2 | Demonstrate proficiency in preprocessing techniques such as cleaning, transformation, and reduction of data. | U | P | Assignment / Seminar presentations/ Exams |
| CO3 | Understand popular data mining algorithms and models, such as decision trees, k-means clustering, and association rule algorithms. | U | P | Seminar Presentation / Group Tutorial Work/ Viva Voce |
| CO4 | Explore various methods to Evaluate and interpret the results of data mining models using appropriate performance metrics. | U | C | Instructor-created exams / Home Assignments |
| CO5 | Understand the role of data mining in extracting patterns and knowledge from large datasets. | U | P | Writing assignments/ exams/ Seminar |
| CO6 | Apply data mining techniques to real-world problems and datasets, emphasizing practical applications in various domains | Ap | P | Case Study |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Data Mining** | | **10** | **15** |
| | 1 | Introduction- Data mining defining, KDD vs Data mining, DBMS vs data mining | 2 | |
| | 2 | What kind of data can be mined? - database data, data warehouse, transactional data, other types | 2 | |
| | 3 | What kind of patterns can be mined? - Class/Concept | 3 | |

| | | | | |
|---|---|---|---|---|
| | | Description: Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Regression for Predictive Analysis, cluster analysis, outlier analysis | | |
| | 4 | Technologies used- statistics, machine learning, data base systems and ware house, information retrieval (Introduction only) | 3 | |
| **II** | **Data Preprocessing** | | **14** | **20** |
| | 5 | Data Preprocessing: An Overview | 2 | |
| | 6 | Data Cleaning- missing value, noisy data, Data Cleaning as a Process | 2 | |
| | 7 | Data Integration- Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution | 3 | |
| | 8 | Data Reduction - Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms, | 4 | |
| | 9 | Data Transformation and and Data Discretization- Data Transformation by Normalization, Discretization by Binning | 3 | |
| **III** | **Association Rule Mining & Classification** | | **10** | **15** |
| | 10 | Introduction to Association Rule Mining Frequent Itemset, Closed Itemset, and Association Rules | 1 | |
| | 11 | Frequent Itemset Mining Apriori Algorithm, Generating Association Rules from Frequent Itemsets | 1 | |
| | 12 | Introductio to classification: Decision tree | 2 | |
| | 13 | Attribute Selection measures in decision tree | 2 | |
| | 14 | Bayes Classification methods | 2 | |
| | 15 | Techniques to Improve Classification Accuracy | 2 | |
| **IV** | **Clustering, Outlier Detection** | | **14** | **20** |
| | 16 | Introduction to unsupervised techniques: challenges | 2 | |
| | 17 | Clustering- K Means | 2 | |
| | 18 | Variants of k- Means | 2 | |
| | 19 | Hierarchical clustering | 2 | |
| | 20 | Density Based clustering- DBScan | 2 | |
| | 21 | Introduction to outliers and novelty detection | 2 | |
| | 22 | Recommender system | 2 | |
| **V** | **Open Ended Module: Case Studies** | | **12** | |
| | 1 | • Real-world applications of data mining<br>• Case studies and projects<br>• Ethical considerations in data mining | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | - | - | - | 1 | | | | | | |
| CO 2 | 1 | - | - | - | 1 | 1 | | | | | | |
| CO 3 | 1 | - | 2 | - | 2 | 2 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | 1 | - | 1 | - | 1 | 1 | | | | | | |
| CO 5 | 1 | - | 1 | - | 1 | 1 | | | | | | |
| CO 6 | - | - | 1 | 1 | 2 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | |

**References:**


1. "Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques. Morgan Kaufmann."
2. Data Mining Techniques - Arun K. Pujari
3. Jiawei Han and Micheline Kamber, "Data Mining Concepts & Techniques", Second Edition, Elsevier.
4. Pang Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction To Data Mining", Pearson Education, 2007.

# BCA7EJ403(1) - Research Methodology in Computer Science

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7EJ403(1) | | | | |
| Course Title | Research Methodology in Computer Science | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Knowledge of Planning a research project, problem formulation, framing objectives | | | | |
| Course Summary | This course introduces and discusses approaches, strategies, and data collection methods relating to research. Students will consider how to select the appropriate methodology for use in a study to be performed. Additionally, these students will learn how to collect data based on different data collection methods, construct these tools, and pilot them before they become ready for use. To culminate this final stage, students will learn to write a comprehensive research proposal that may be conducted in the future | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the psychology of research which includes different perspectives and necessity of research. | U | C | Instructor-created exams / Quiz |
| CO2 | Apply the research knowledge to formulate a suitable problem statement by adopting different research methods and models | U | C | Instructor-created exams / Quiz |
| CO3 | Understand different methods of Collection, Validation and Testing of Data | U | P | Instructor-created exams / Quiz |
| CO4 | To understand the data processing and analysis techniques | U | C | Instructor-created exams / Case studies |
| CO5 | Analyze the research outcome by using suitable statistical tool. | U | P | Instructor-created exams / Quiz Case studies |
| CO6 | To write or present a scientific report and research proposal | U | P | Instructor-created exams / Quiz /Case studies |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

## Detailed Syllabus

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Research Methodology** | | **12** | **15** |
| | 1 | Research Methodology: An Introduction to the Meaning of Research and Objectives of Research | 2 | |
| | 2 | Motivation in Research, Types of Research | 2 | |
| | 3 | Research Approaches | 2 | |
| | 4 | Significance of Research | 3 | |
| | 5 | Research Methods versus Methodology | 3 | |
| **II** | **Identifying, Defining and Designing Research Problem** | | **12** | **15** |
| | 6 | Defining the Research Problem What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem | 2 | |
| | 7 | Technique Involved in Defining a Problem | 1 | |
| | 8 | Research Design: Meaning of Research Design, Need for Research Design | 3 | |
| | 9 | Research Methodology,Features of a Good Design | 3 | |
| | 10 | Important Concepts Relating to Research Design | 1 | |
| | 11 | Different Research Designs | 2 | |
| **III** | **Collection, Validation and Testing of Data** | | **12** | **20** |
| | 12 | Sources of Data: Primary and Secondary, Validation of Data, Data Collection Methods: Questionnaire Designing | 2 | |
| | 13 | Construction Sampling Design & Techniques – Probability Sampling and Non-Probability Sampling Scaling Techniques: | 2 | |
| | 14 | Meaning & Types Reliability: Test – Retest Reliability | 2 | |
| | 15 | Alternative Form Reliability | 2 | |
| | 16 | Internal Comparison Reliability and Scorer Reliability | 2 | |
| | 17 | Validity: Content Validity, Criterion Related Validity and Construct Validity | 2 | |
| **IV** | **Data Processing and Analysis** | | **12** | **20** |
| | 18 | Processing and Analysis of Data, Processing Operations, Some Problems in Processing, Elements/Types of Analysis | 2 | |
| | 19 | Statistics in Research Measures of Central Tendency | 2 | |
| | 20 | Measures of Dispersion Interpretation and Report Writing | 3 | |
| | 21 | Meaning of Interpretation Why Interpretation? Technique of Interpretation: Precaution in Interpretation | 2 | |
| | 22 | Significance of Report Writing Different Steps in Writing Report Layout of the Research Report | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | **CASE STUDY: RESEARCH METHODOLOGY**<br>Methods of Research<br>Applications of Statistical tools & Methods<br>Structure and components of scientific reports | | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | | | | | | |
| CO2 | - | - | 1 | - | - | - | | | | | | |
| CO3 | 1 | 2 | 1 | - | 1 | 1 | | | | | | |
| CO4 | 1 | 2 | 2 | 2 | 1 | 2 | | | | | | |
| CO5 | 1 | 1 | 2 | 2 | 1 | 2 | | | | | | |
| CO6 | - | - | - | - | - | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**Reference:**

1. C. R. Kothari, 'Research Methodology Methods & Techniques', Revised 2 nd Edn., New Age International Publishers.

2. Research Methodology and Scientific Writing by C George Thomas, Ane Books Pvt. Ltd.,

3. An Introduction to Research Methodology; Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002., RBSA Publishers.

4. Research Methodology; Panneerselvam R., PHI, Learning Pvt. Ltd., New Delhi - 2009

5. Research Methodology: Concepts and cases, Chawala D. and N. Sondhi; Vikas Publishing House Pvt. Ltd.

## BCA7OE401(1) - Ethical Hacking

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7OE401(1) | | | | |
| Course Title | Ethical Hacking | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Understanding of the fundamental networking and protocols concepts.<br>2. Familiarity with various operating systems, file systems and basic system administration tasks. | | | | |
| Course | This course provides the skills to identify, analyze, and address security | | | | |

| | |
|---|---|
| Summary | vulnerabilities in systems, networks, and web applications. It aims to learn to perform penetration testing, conduct reconnaissance, exploit vulnerabilities, and maintain access ethically and legally. |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the fundamentals of Ethical Hacking | U | C | Instructor- created exams / Quiz |
| CO2 | Learn the features of Foot Printing and Reconnaissance | Ap | P | Assignment / Seminar presentations/ Exams |
| CO3 | Apply the System Hacking methods | Ap | P | Seminar Presentation/ Group Tutorial Work/ Viva Voce |
| CO4 | Understand attacks and type of attacks Apply reasoning with ontologies and rules | U | C | Instructor- created exams / Home Assignments |
| CO5 | Apply various Penetration Testing methods | Ap | C | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Develop theoretical concept on various types of attacks and apply the platforms to explore them. | Ap | P | Case Study/ Group discussions/ Presentations |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| **I** | | **Fundamentals of Ethical Hacking** | **15** | **15** |
| | 1 | Information security overview, Introduction to Hacking, importance of Security – Elements of Security | 2 | |
| | 2 | Hacking Concepts and Hacker Classes - Phases of Hacking Cycle, | 3 | |
| | 3 | Ethical Hacking Tools - Threat and Threat Sources - Malware and Components of Malware - | 4 | |
| | 4 | Types of Malwares, Types of Hackers | 3 | |
| | 5 | Common Hacking Methodologies, Benefits and challenges of Ethical Hacking, | 3 | |
| **II** | | **Foot Printing & Reconnaissance** | **12** | **20** |
| | 6 | Foot Printing & Reconnaissance: Foot printing concepts, Use of foot printing, | 2 | |
| | 7 | information gathering, Types of foot printing, Website Foot printing | 2 | |
| | 8 | Foot printing through Search Engines, Foot Printing through Social Networking sites | 2 | |
| | 9 | Foot Printing tools, Understanding the information gathering | 2 | |

| | | | | |
|---|---|---|---|---|
| | | process, | | |
| | 10 | Website Foot printing, WHOIS Foot printing, | 2 | |
| | 11 | Network Scanning, Port scanning, | 1 | |
| | 12 | Tools used for the reconnaissance phase | 1 | |
| **III** | **System Hacking** | | **11** | **20** |
| | 13 | Password Cracking - Types of Password Attacks | 1 | |
| | 14 | Password Cracking Tools and vulnerabilities | 1 | |
| | 15 | Identity Theft - Social Engineering and tools | 2 | |
| | 17 | Types of attacks and their common prevention mechanisms | 2 | |
| | 17 | Keystroke Logging, Denial of Service (DoS /DDoS), | 2 | |
| | 18 | Waterhole attack, brute force, phishing and fake WAP, Session Hijacking | 3 | |
| **IV** | **Penetration Testing** | | **10** | **15** |
| | 19 | Introduction to Penetration Testing, Types of Penetration Testing- | 2 | |
| | 20 | Phases of Penetration Testing, | 3 | |
| | 21 | pen testing, type of pen testing. | 3 | |
| | 22 | Tools of Penetration Testing, Test web applications for vulnerabilities | 2 | |
| **V** | **Open Ended Module- Mobile, cloud and IoT Based attacks, Kali Linux** | | **12** | |
| | 1 | Mobile Platform Attack | 3 | |
| | 2 | Cloud level Attacks and Tools | 2 | |
| | 3 | IoT based attacking Tools | 3 | |
| | 4 | Kali Linux | 4 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | - | - | 1 | 1 | | | | | | |
| CO 2 | 3 | - | - | - | 1 | 1 | | | | | | |
| CO 3 | 1 | 3 | 1 | 1 | 2 | 3 | | | | | | |
| CO 4 | 1 | - | 1 | 1 | 2 | 3 | | | | | | |
| CO 5 | 1 | - | - | - | 2 | 3 | | | | | | |
| CO 6 | 1 | 2 | 1 | 1 | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | End Semester Examinations |
|---|---|---|---|
| CO 1 | ✓ | | ✓ |
| CO 2 | ✓ | | ✓ |
| CO 3 | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | ✓ |
| CO 5 | ✓ | ✓ | ✓ |
| CO 6 | ✓ | ✓ | |

**Reference:**

1. Stuttard, D., & Pinto, M. (2011). The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws (2nd ed.). Wiley. ISBN: 978-1118026472

2. Erickson, J. (2008). Hacking: The Art of Exploitation (2nd ed.). No Starch Press. ISBN: 978-1593271442

3. Baloch, R. (2017). Ethical Hacking and Penetration Testing Guide. CRC Press. ISBN: 978-1138197396

4. Harper, A., Regalado, D., & others. (2015). Gray Hat Hacking: The Ethical Hacker's Handbook (4th ed.). McGraw-Hill Education. ISBN: 978-0071832380

5. Kennedy, D., O'Gorman, J., Kearns, D., & Aharoni, M. (2011). Metasploit: The Penetration Tester's Guide. No Starch Press. ISBN: 978-1593272883

# BCA7OE401(2) - Cyber Forensics

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA7OE401(2) | | | | |
| Course Title | Cyber Forensic | | | | |
| Type of Course | Elective | | | | |
| Semester | VII | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Understanding concept Computer Hardware, Operating System<br>2. Knowledge of information security concepts, including confidentiality, integrity, and availability<br>3. Knowledge of legal and ethical issues surrounding digital evidence collection, preservation, and analysis is crucial for conducting forensic investigations in compliance with applicable laws and regulations. | | | | |
| Course Summary | This course provides an overview of cyber forensics and cyber laws, focusing on the principles, techniques, and legal considerations involved in investigating cybercrimes, preserving digital evidence, and navigating legal frameworks governing cybersecurity. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To understand the fundamental concepts, principles, and methodologies of cyber forensics | Ap | C | Instructor-created exams / Quiz |
| CO2 | To develop skills in acquiring preserving, and analysing digital evidence from various source | Ap | P | Assignment / Seminar presentations/ Exams |
| CO3 | To learn and understand techniques and tools to investigate cybercrimes, security incidents, and data breaches. | Ap | P | Seminar Presentation/ Group Tutorial Work/ Viva Voce |
| CO4 | Demonstrate proficiency in conducting network, disk, memory, and mobile device forensics examinations. | Ap | P | Instructor-created exams / Home Assignments |
| CO5 | Evaluate ethical, legal, and privacy considerations in cyber forensics investigations and evidence handling. | E | M | Writing assignments/ Exams/ Seminar Presentations |
| CO6 | Apply critical thinking, problem-solving, and decision-making skills to address challenges in cyber forensics and cybersecurity. | Ap | P | Case Study/ Group discussions/ Presentations |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) | | | | |

# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **INTRODUCTION TO CYBER FORENSICS** | | **10** | **15** |
| | 1 | Computer Forensics Fundamentals: What is Computer Forensics? Use of Computer Forensics in Law Enforcement, Computer Forensics Services | 2 | |
| | 2 | Computer Forensics Assistance: Human Recourses/Employment Proceedings, Benefits of professional Forensics Methodology, Steps taken by Computer Forensics Specialists | 2 | |
| | 3 | Computer Forensics Technology: Business Computer Forensic Technology, Military Computer Forensic Technology, Law Enforcement | 2 | |
| | 4 | Vendor and Computer Forensics Services: Types of services provided by vendors, Criteria for selecting a computer forensics vendor, Vendor Engagement and Contracts, Evaluation of vendor capabilities, expertise and reputation | 2 | |
| | 5 | Cyber forensics tools and case studies: Disk Imaging (EnCase, FTK), File Analysis (FileInsight and ExifTool), | 2 | |
| **II** | **COMPUTER FORENSICS EVIDENCE** | | **10** | **15** |
| | 6 | Computer forensics evidence and capture: Why Collect Evidence, Types of Evidence, The Rules of Evidence, Volatile Evidence, | 2 | |
| | 7 | Data Recovery: Definition, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data -Recovery Solution | 2 | |
| | 8 | General Procedure for Data Collection: Collection and Archiving, Methods of Collection | 2 | |
| | 9 | Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events. | 2 | |
| | 10 | Controlling Contamination: The Chain of Custody, Reconstructing the Attack, The digital crime scene, Investigating Cybercrime, Investigating Web attacks, Investigating network Traffic | 2 | |
| **III** | **FORENSIC ANALYSIS AND VALIDATION** | | **14** | **20** |
| | 11 | Computer image Verification and Authentication: Special needs of Evidential Authentication, | 2 | |
| | 12 | Computer forensic analysis: Determining what data to collect and analyse, validating forensic data, addressing data-hiding techniques, performing remote acquisitions | 2 | |
| | 13 | Computer forensic validation: Validating forensic data, addressing data-hiding techniques, performing remote acquisitions | 2 | |
| | 12 | Network Forensics: Network forensic overview, Performing live acquisitions, Developing standard procedures for network forensics | 2 | |
| | 13 | Network Forensic Tools: Overview, Wireshark, tcpdump, and | 2 | |

| | | | | |
|---|---|---|---|---|
| | | NetworkMiner, Network Traffic Analysis Tools | | |
| | 14 | Ethical Hacking: Essential Terminology, Windows Hacking, Malware, Scanning, Cracking. | 2 | |
| | 15 | Tactics of the Military, Tactics of Terrorist and Rogues, Tactics of Private Companies | 2 | |
| **IV** | **CYBER CRIME AND CYBER LAW** | | **14** | |
| | 16 | Mobile device forensics: Understanding mobile device forensic, understanding acquisition procedures for cell phones and mobile devices. | 2 | **20** |
| | 17 | Cyber Crimes: Types of cybercrimes against individuals and institution, States-various offenses and punishments | 2 | |
| | 18 | Digital Signature: Concepts of public key and private key, Certification Authorities and their role, Creation and authentication of digital signature. | 2 | |
| | 19 | E-contracting: Features of E-contracts, Formation of E-contracts and types | 2 | |
| | 20 | E-governance: E-governance models, E-commerce- salient features and advantages. | 2 | |
| | 21 | Cyber Law: Understanding cyber space, Defining cyber law, Scope and jurisprudence | 2 | |
| | 22 | Indian Cyber Law: Overview of Indian legal system, Introduction to IT Act 2000, Amendment in IT Act. | 2 | |
| **V** | **Open Ended Module** | | **12** | |
| | | 1. Case Study.<br>2. Simulate real-world cyber incidents and develop incident response plans.<br>3. An activity that emphasizes teamwork, communication, and decision-making under pressure.<br>4. Work on a comprehensive cyber forensics project that integrates concepts from multiple areas of study.<br>5. Apply forensic techniques to investigate a real or simulated cyber incident and produce a detailed report. | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | - | - | - | 2 | 1 | | | | | | |
| CO 2 | 2 | - | - | - | 2 | 1 | | | | | | |
| CO 3 | 2 | - | - | - | 3 | 2 | | | | | | |
| CO 4 | 1 | - | - | - | 1 | 1 | | | | | | |
| CO 5 | 2 | -- | - | -- | 3 | 1 | | | | | | |
| CO 6 | 3 | | - | | 2 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, John R. Vacca, Charles River Media, 2005
2. Cyber Forensics - Concepts and Approaches, Ravi Kumar & B Jain,2006, ICFAI university press
3. Understanding Cryptography: A Textbook for Students and Practitioners, ChristofPaar, Jan Pelzl, 2010, Second Edition, Springer's.
4. Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri, First edition, 2009
5. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010.

# BCA8EJ404(1) - Compiler Design

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA8EJ404(1) | | | | |
| Course Title | Compiler Design | | | | |
| Type of Course | Elective | | | | |
| Semester | VIII | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1.Formal Languages & Automata Theory.<br>2.Data Structure and Algorithms | | | | |
| Course Summary | This course covers the fundamental concepts of different phases of compilation such as lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation. Students can apply this knowledge in design and development of compilers. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To identify different phases in compilation process and model a lexical analyser. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO2 | To model language syntax using Context Free Grammar and develop parse tree representation using leftmost and rightmost derivations. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | To compare different types of parsers and construct parser for a given grammar. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | To build Syntax Directed Translation for a context free grammar, compare various storage allocation strategies and classify intermediate representations. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Students will demonstrate the ability to design and implement lexical analyzers to recognize tokens in source programs. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Illustrate code optimization and code generation techniques in compilation | Ap | P | Practical Assignment / |

| | | | | |
|---|---|---|---|---|
| | | | | Instructor-created exams / Quiz |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Mark |
|---|---|---|---|---|
| **I** | **COMPILERS AND LEXICAL ANALYSIS** | | **10** | **15** |
| | 1 | Analysis of the source program - Analysis and synthesis phases | 2 | |
| | 2 | Phases of a compiler, The grouping of Phases | 2 | |
| | 3 | Compiler writing tools. Bootstrapping. | 2 | |
| | 4 | Lexical Analysis: Parsing, Abstract stack machine, Role of Lexical Analyser | 2 | |
| | 5 | Input Buffering, Specification of Tokens, Recognition of Tokens. | 2 | |
| **II** | **SYNTAX ANALYSIS** | | **18** | **25** |
| | 6 | Role of the Syntax Analyser, Role of the Parser | 2 | |
| | 7 | Context-free grammars, Prase Tree and Derivations, Eliminating Ambiguity | 2 | |
| | 8 | Basic Parsing Approaches – Eliminating left recursion, left factoring | 3 | |
| | 9 | Top Down parsing - Recursive Descent Parsing | 2 | |
| | 10 | Predictive Parsing – LL (1) Grammars | 3 | |
| | 11 | Bottom-up parsing -Handle Pruning - Shift Reduce Parsing - Operator Precedent Parsing | 3 | |
| | 12 | LR Parsers - SLR Parser- Canonical LR Parser - LALR Parser | 3 | |
| **III** | **SEMANTIC ANALYSIS AND INTERMEDIATE CODE GENERATION** | | **10** | **15** |
| | 13 | Syntax directed translation - Syntax directed definitions | 2 | |
| | 14 | S-attributed definitions, L-attributed definitions, Bottom-up evaluation of S-attributed definitions. Run-Time Environments | 2 | |
| | 15 | Source Language issues, Storage organization, Storage-allocation strategies. | 2 | |
| | 16 | Intermediate Code Generation - Intermediate languages, Graphical representations, | 2 | |
| | 17 | Three-Address code, Quadruples, Triples. | 2 | |
| **IV** | **CODE OPTIMIZATION AND CODE GENERATION** | | **10** | **15** |
| | 18 | Code Optimization - Principal sources of optimization | 2 | |
| | 19 | Machine dependent and machine independent optimizations, | 2 | |
| | 20 | Local and global optimizations. | 2 | |

| | | | | |
|---|---|---|---|---|
| | 21 | Code generation - Issues in the design of a code generator, | 2 | |
| | 22 | Target Language, A simple code generator. | 2 | |
| **V** | **Open Ended Module – Application Level** | | **12** | |
| | | 1. Learn the fundamentals of lexical analysis and parsing using Lex and Yacc, essential tools in compiler construction.<br>2. Apply the concepts learned to develop a small compiler, progressively enhancing its functionality while implementing error handling and optimization strategies.<br>3. Apply the concept of Bootstrapping and its significance in compiler construction.<br>4. Understanding of run-time environments and storage allocation strategies.<br>5. Development of a simple code generator for translating intermediate code into target code. | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | - | 1 | 2 | 2 | 2 | - | | | | | | |
| CO 2 | - | 1 | 2 | 2 | 2 | - | | | | | | |
| CO 3 | 1 | 1 | 2 | 3 | 3 | - | | | | | | |
| CO 4 | 1 | - | 2 | 3 | 3 | - | | | | | | |
| CO 5 | 1 | - | 2 | 2 | 2 | - | | | | | | |
| CO 6 | - | - | 2 | 1 | 2 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Aho A.V., Ravi Sethi and D. Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.

2. D.M. Dhamdhere, System Programming and Operating Systems, Tata McGraw Hill &Company, 1996.

3. Kenneth C. Louden, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.

4. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company,1984.

5. Compiler Design in C, Allen I. Holub, Prentice Hall (Software Series).

6. Crafting a Compiler with C, C. N. Fischer and R. J. LeBlanc, Pearson Education.

7. Allen I Holub, Compiler Design in C, 1st Edition, PHI Learning Pvt Ltd.

## BCA8EJ404(2) - Mixed Reality

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA8EJ404(2) | | | | |
| Course Title | Mixed Reality | | | | |
| Type of Course | Elective | | | | |
| Semester | VIII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |

| | |
|---|---|
| Pre-requisites | No pre-requisites required |
| Course Summary | This course explores the principles and applications of Mixed Reality-Virtual Reality (VR) and Augmented Reality (AR), covering topics including Tracking, Motion, Interaction and Navigation. Students will delve into the technical foundations, design considerations, and emerging techniques shaping the development and utilization of VR and AR technologies in various fields. |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand about virtual reality, creation of immersive VR experiences and human physiology's interaction with the virtual environments. | U | C | Instructor- created exams / Quiz/Assignment/ Seminar |
| CO2 | Able to proficiently define the geometry of the virtual world containing transformations and optics that definethe human perception. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO3 | Acquire a comprehensive understanding of different techniques used for visual perception and visual rendering for the creation of virtual world | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO4 | Understand how the motion in virtual world happens, the experiments conducted, and how the evaluation of VR systems are carried out | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO5 | Familiarize with the concept of Augmented Reality, their characteristics and various the tracking technologies used in the process. | U | C | Instructor-created exams/ Quiz/Assignment/ Seminar |
| CO6 | A comprehensive understanding of the output and input modalities used for navigation, and the software engineering requirements needed for the development of AR technologies. | U | C | Instructor-created exams/ Quiz/Assignment / Seminar |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Contents | Hrs (48+12) | Mark |
|---|---|---|---|---|
| I | | **Virtual Reality** | **16** | **20** |
| | 1 | What is Virtual Reality? | 1 | |

| | | | | |
|---|---|---|---|---|
| | 2 | Modern VR experiences, History repeats | 2 | |
| | 3 | Hardware, Software | 2 | |
| | 4 | Human physiology and Perception | 3 | |
| | 5 | Geometry of virtual world- Geometric models, Changing position and orientation | 3 | |
| | 6 | Light and optics – Basic behavior light, Lenses | 2 | |
| | 7 | Optical aberrations, Human eye, Cameras, Displays | 3 | |
| **II** | **Implementation of Virtual World** | | **16** | **20** |
| | 8 | Perception of Depth, Perception of Motion, Perception of Colour | 4 | |
| | 9 | Ray tracing and Shading models, Rasterization | 4 | |
| | 10 | Motion in real and virtual world – Velocities, Acceleration, The Vestibular system (no diagram required) | 3 | |
| | 11 | Physics in the virtual world, Mismatched motion and vection | 3 | |
| | 12 | Evaluating VR systems and experiences – Perceptual training, Experiments on human subjects - scientific method, Human subjects, Ethical standards | 2 | |
| **III** | **Augmented Reality** | | **08** | **15** |
| | 13 | Introduction - Definition and scope | 1 | |
| | 14 | Tracking - Coordinate systems, Model transformation, View transformation, Projective transformation | 1 | |
| | 15 | Characteristics of tracking technology – Physical phenomena, Measurement principle, Measured geometric property, Sensor arrangement, Signal sources | 2 | |
| | 16 | Stationary tracking systems – Mechanical, Electromagnetic, Ultrasonic | 2 | |
| | 17 | Mobile sensors – GPS, Wireless networks, Magnetometer, Gyroscope | 2 | |
| **IV** | **Interaction, Navigation and Requirements** | | **08** | **15** |
| | 18 | Output modalities - Augmentation Placement, Agile Displays, Magic Lenses | 1 | |
| | 19 | Input modalities- Tracking and Manipulation of Rigid Objects, Body Tracking, Gestures | 1 | |
| | 20 | Foundations of human navigation | 2 | |
| | 21 | Exploration and discovery, Route visualization | 1 | |
| | 22 | Software engineering requirements - Platform Abstraction, User Interface Abstraction, Reusability and Extensibility, Distributed Computing, Decoupled Simulation | 3 | |
| **V** | **Open Ended Module** | | **12** | |

| | | | | |
|---|---|---|---|---|
| | | • Comparative analysis of VR applications in different industries such as healthcare, education, entertainment, and training.<br>• Study of the impact of AR on social interaction and communication patterns.<br>• Evaluation of AR games and entertainment experiences, including case studies of popular AR games and immersive storytelling experiences.<br>• Case studies of successful or unsuccessful VR projects, analysing factors contributing to their outcomes.<br>• Exploration of ethical considerations in VR development and usage, considering issues like privacy, safety, and psychological impact. | 12 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | - | - | - | - | | | | | | |
| CO 2 | 2 | - | - | - | - | - | | | | | | |
| CO 3 | 2 | 2 | - | - | - | - | | | | | | |
| CO 4 | 2 | 2 | - | - | 2 | 1 | | | | | | |
| CO 5 | 1 | - | - | - | 2 | - | | | | | | |
| CO 6 | 2 | 2 | - | - | - | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Steven M. LaValle, “Virtual Reality”, Cambridge university Press, 2020.
2. Dieter Schmalstieg, Tobias Hollerer “ Augmented Reality: Principles and Practice”, Addison-Wesley, 2016.
3. Gregory C. Burdea & Philippe Coiffet “Virtual Reality Technology”, John Wiley & Sons, 2017.

## BCA8EJ405(1) - Mastering Java Web Development

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA8EJ405(1) | | | | |
| Course Title | Mastering Java Web Development | | | | |
| Type of Course | Elective | | | | |
| Semester | VIII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Knowledge in core concept of Java Programming<br>2. Knowledge of database concept and SQL<br>3. Knowledge in basic web concept like HTML, CSS, JavaScript | | | | |
| Course Summary | The aim of this course is to provide students with a thorough understanding of building dynamic web applications using Java technologies. This course covers essential concepts, frameworks, and | | | | |

| | |
|---|---|
| | tools necessary for developing robust, scalable, and secure web applications. |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To understand the concept of web development principles, including client-server architecture, HTTP protocol, and web application lifecycle. | U | C | Instructor-created exams / Home assignments |
| CO2 | Acquire proficiency in Java web technologies as Java Server Page. | Ap | P | Instructor-created exams / Home assignments |
| CO3 | Understand the Model-View-Controller (MVC) architecture pattern and its implementation in Java web applications using frameworks like Spring MVC. | Ap | P | Instructor-created exams / Home assignments |
| CO4 | Gain knowledge of web services concepts, including RESTful web services and SOAP-based web services, and learn to develop and consume web services using Java technologies. | Ap | P | Instructor-created exams / Home assignments |
| CO5 | Gain a deep understanding of the principles behind AJAX, including asynchronous communication. | Ap | P | Instructor-created exams / Home assignments |
| CO6 | Understand how to handle AJAX requests on the server-side using technologies such as JSP and Spring MVC. | Ap | P | Instructor-created exams / Home assignments |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Over View of Core Java** | | **7** | **9** |
| | 1 | Core Java Concept: Class, Inheritance, Constructor, Exception and Multithreading | 3 | |
| | 2 | Overview of JDBC: JDBC Concept, Execution of SQL Statements, Transaction Management | 2 | |
| | 3 | Introduction to Web Applications, Web Servers Overview of J2EE Technologies. | 2 | |
| **II** | **Introduction to JSP** | | **12** | **15** |

| | | | | |
|---|---|---|---|---|
| | 3 | Fundamental Concept of JSP: JSP & Servlet as Web Components, Servlets vs. JSP | 2 | |
| | 4 | Working with JSP: JSP Lifecycle, JSP Page Lifecycle Phases | 2 | |
| | 5 | General Rules of Syntax: JSP syntactic elements, JSP element syntax, Template content | 3 | |
| | 6 | JSP elements: Directives, Declarations, Expressions, Scriptlets, Actions | 3 | |
| | 7 | JSP Standard Actions: jsp:useBean, jsp:getPreoperty, jsp:setProperty, jsp:include, jsp:forward, jsp:plugin,jsp:param, Java Server Pages Standard Tag Library(JSTL). | 2 | |
| **III** | **Introduction to Spring MVC** | | **16** | **23** |
| | 8 | Getting Started with Spring: Overview of the MVC Architecture, Spring Framework and its relevance in web development, Advantages and benefits of using Spring MVC for building web applications. | 2 | |
| | 9 | Initializing a Spring project with Spring Tool Suite: Simple Example and Sample example analysis, Spring Project Structure | 2 | |
| | 10 | Writing a Spring Application: Handling Web request, Defining the view, Testing the Controller, Building and Running application | 2 | |
| | 11 | Developing Web Application: Establishing thedomain, creating the controller class, Designing the view, Form submission. | 2 | |
| | 12 | Working with View Controller: Declaring validation rule, Performing validation, Caching templates. | 2 | |
| | 13 | Working with Data: Working with JDBC, Defining the Schema and pre-loading data, Inserting data | 2 | |
| | 14 | Working with Spring Data JDBC: Adding Spring data JDBC, Defining the repository interface, Preloading data with CommandLineRunner | 2 | |
| | 15 | Exception Handling: Handling exceptions gracefully in Spring MVC applications, Implementing global exception handlers and custom error pages. | 1 | |
| | 16 | Securing Spring: Introduction to Spring Security, Configuring authentication, authorization, and access control. | 1 | |
| **IV** | | **Integrated Spring and AJAX** | **13** | **23** |
| | 17 | Creating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters. | 2 | |
| | 18 | Introduction to AJAX: Ajax Fundamentals, JavaScript Libraries, The Prototype Library, Technique Library, Form Completion | 2 | |

| | | | | |
|---|---|---|---|---|
| | 19 | Validation: Realtime Validation, Propagating Client-Side View State, Direct Web Remoting | 2 | |
| | 20 | Handling Ajax Requests in Spring MVC: Mapping Ajax request URLs using @RequestMapping annotations. Parsing request parameters and payloads in Spring MVC controllers. Implementing server-side processing logic for Ajax requests. | 3 | |
| | 21 | Form Submission and Validation with Ajax: Submitting forms via Ajax requests in Spring MVC. Validating form inputs on the server-side usingSpring's validation framework. Displaying validation errors and messages to the user without page reloads. | 2 | |
| | 22 | Advanced Ajax Technique: Cross-Origin Resource Sharing, CSRF protection, Content Security Policy, caching, throttling, lazy loading | 2 | |
| **V** | **Practical Applications, Case Study and Course Project** | | **12** | |
| | 1 | Discuss topics from the following:<br>• Impact of Servlet<br>• The version of Spring MVC.<br>• Exception handling in Web Application.<br>• RESTful API.<br>• Basics of CRUD Operations | 8 | |
| | 2 | **Project:** Build a web application for library management system using Spring MVC (Eg: Admin Login, Inserting Book details, stock management, Book issue, display book catelog) | 4 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 3 | 3 | - | - | | | | | | |
| CO 2 | 1 | - | 3 | 3 | - | - | | | | | | |
| CO 3 | - | - | 3 | 3 | 2 | 3 | | | | | | |
| CO 4 | - | - | 2 | 3 | - | - | | | | | | |
| CO 5 | - | - | 3 | 3 | 2 | 3 | | | | | | |
| CO 6 | | | 3 | 3 | 3 | | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |

| | |
|---|---|
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |

**References:**

1. Spring in Action, Sixth Edition by Craig Walls - 2022
2. Introducing Spring Framework 6: Learning and Building Java-based Applications with Spring - 2022 by Felipe Gutierrez, Joseph B. Ottinger
3. Pro Spring 3 (Expert's Voice in Spring) – 2012 by Clarence Ho, Rob Harrop
4. Ajax: The Complete Reference by Thomas Powell

## BCA8EJ405(2) - Social Network Analysis

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA8EJ405(2) | | | | |
| Course Title | Social Network Analysis | | | | |
| Type of Course | Elective | | | | |
| Semester | VIII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Knowledge in Fundamentals of Data Mining | | | | |

| | |
|---|---|
| Course Summary | The syllabus is prepared with the view of preparing the BSc Computer Science Graduates to build a basic understanding of what social network analysis is and how it can be applied. Topics covered include network structure and methods for social network analysis, link analysis and network community detection, information propagation on the web and some applications. |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the basic notation and terminology used in social network analysis. | U | C | Instructor-created exams / Quiz |
| CO2 | Compare and interpret social network structure, size and its connectivity pattern. | U | C | Instructor-created exams / Quiz |
| CO3 | Discover community structure in complex network using statistical techniques | U | P | Instructor-created exams / Quiz |
| CO4 | Apply link prediction techniques to discover new links in the social network | U | C | Instructor-created exams / Case studies |
| CO5 | Describe influence in social media, perform recommendations | U | P | Instructor-created exams / Quiz Case studies |
| CO6 | Perform Social Influence Analysis | U | P | Instructor-created exams / Quiz /Case studies |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

## Detailed Syllabus

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction to Social Network Data Analytics** | **12** | **15** |
| | 1 | Introduction to Social Network Analysis | 2 | |
| | 2 | Online social networks Research Issues and Topics | 2 | |
| | 3 | Statistical properties of social networks: Preliminaries | 2 | |
| | 4 | Static properties, Dynamic properties | 3 | |
| | 5 | Challenges of Social Network Streams | 3 | |
| **II** | | **Random Walks in Social Networks** | **12** | **15** |
| | 6 | Random walks on Graphics, Walks based on proximity measures | 2 | |
| | 7 | Other graph based proximity measures | 1 | |
| | 8 | Graph theoretic measures for semi supervised learning | 3 | |
| | 9 | Clustering with random walk based measures | 3 | |
| | 10 | Applications in computer vision Text Analysis, Evaluation and datasets | 1 | |
| | 11 | Link prediction and data sources | 2 | |
| **III** | | **Community Discovery in Social Networks** | **12** | **20** |
| | 12 | Communities in Context | 2 | |
| | 13 | Core Methods – KL Algorithm, Special algorithms | 2 | |
| | 14 | Markov Clustering, other approaches | 2 | |
| | 15 | Emerging Fields and problems: Community Discovery in dynamic networks | 2 | |
| | 16 | Heterogeneous networks, Directed networks, | 2 | |
| | 17 | Coupling content and relationship information for community discovery | 2 | |
| **IV** | | **Link Prediction in Social Networks** | **12** | **20** |
| | 18 | Background, Feature based Link Prediction, Bayesian Probabilistic Models | 3 | |
| | 19 | Probabilistic Relational Models | 2 | |
| | 20 | Linear Algebraic Methods | 2 | |
| | 21 | Link Predictions: The Katz Score, Hitting & Commute Time | 2 | |
| | 22 | Rooted PageRank, SimRank | 3 | |
| **V** | | **Open Ended Module** | **12** | |
| | | **CASE STUDY: Social Influence Analysis**<br>Influence Related Statistics,<br>Social Similarity and Influence,<br>Influence Maximization in Viral Marketing | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | 2 | - | 1 | 1 | 3 | | | | | | |
| CO2 | - | 3 | - | 1 | 1 | 2 | | | | | | |
| CO3 | 1 | 3 | - | 1 | 1 | 1 | | | | | | |
| CO4 | 1 | 2 | - | - | 1 | 1 | | | | | | |
| CO5 | - | 1 | 1 | - | 1 | 1 | | | | | | |
| CO6 | - | 1 | 1 | - | 1 | 1 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**Reference:**

1. Charu.C. Aggarwal, Social Network Data Analytics, Springer Science+Business Media, LLC 2011.
2. R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014.
3. Krishna Raj P M, Ankith Mohan, K G Srinivasa, Practical Social Network Analysis with Python, Springer Liu, Bing. Web data mining. Springer-Verlag Berlin Heidelberg, 2007.
4. Chakrabarti, Soumen. Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann, 2003.
5. Scime, Anthony, ed. Web mining: applications and techniques. IGI Global, 2005.

## BCA8EJ406(1) - System Security

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA8EJ406(1) | | | | |
| Course Title | System Security | | | | |
| Type of Course | Elective | | | | |
| Semester | VIII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Knowledge in Fundamentals of Network and Operating System and COA | | | | |
| Course Summary | The syllabus is prepared with the view of preparing Bachelor of Computer Application (BCA) Graduates to build effective an understanding of the differences between various forms of computer system security, where they arise, and appropriate tools to achieve them | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the different types of securities in information and computer systems, security goals and confidentiality, integrity, availability | U | C | Instructor-created exams / Quiz |
| CO2 | Outline computer system threats and various types of system attacks | U | C | Instructor-created exams / Quiz |
| CO3 | Identify different issues associated with system attacks and how attacking occurs and various types of attackers | U | P | Instructor-created exams / Quiz |

| | | | | |
|---|---|---|---|---|
| CO4 | Provide knowledge in operating system security, file protections, security assurance | U | C | Instructor-created exams / Case studies |
| CO5 | Understand important elements of Database security | U | P | Instructor-created exams / Quiz Case studies |
| CO6 | Define security planning, various types of security policies and risk analysis | U | P | Instructor-created exams / Quiz /Case studies |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

## Detailed Syllabus

| Module | Unit | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Notion of Different types of Securities** | | **12** | **15** |
| | 1 | Information security - computer security - security goals, relation between security, confidentiality, integrity, availability and authorization, vulnerabilities - principles of adequate protection. | 3 | |
| | 2 | Notions of operating security, database security, program security, network security attacks - threats, vulnerabilities and controls. | 3 | |
| | 3 | The kind of problems - interception, interruption, modification, fabrication. | 2 | |
| | 4 | Computer criminals - amateurs, crackers, career criminals. | 2 | |
| | 5 | Methods of defence control, hardware controls, software controls, effectiveness of controls. | 2 | |
| **II** | **Program Security** | | **12** | **15** |
| | 6 | Secure programs - fixing faults, unexpected behaviour, types of flaws. | 2 | |
| | 7 | Non-malicious program errors - buffer overflows, incomplete mediation. | 1 | |
| | 8 | Viruses and other malicious code - kinds of malicious code, how viruses attach, how viruses gain control, prevention, | 3 | |
| | 9 | Control example - the brain virus, the internet worm, web bugs. | 3 | |
| | 10 | Targeted malicious code - trapdoors, Salami attack | 1 | |
| | 11 | Controls against program threats - development controls, peer reviews, hazard analysis | 2 | |
| **III** | **Operating System Security** | | **12** | **20** |
| | 12 | Protected objects and methods of protection - memory address protection - fence, relocation, base/bounds registers, taggedarchitecture, segmentation, paging. | 2 | |
| | 13 | Control of access to general objects - directory, access control list | 2 | |
| | 14 | File protection mechanism - basics forms of protection, single permissions. | 2 | |
| | 15 | Authentication - authentication basics, password, authentication process challenge - response, biometrics | 2 | |
| | 16 | Trusted operating systems - security policies for operating systems | 2 | |
| | 17 | Models of security - requirement of security systems, multilevel security, access security, limitations of security systems | 2 | |
| **IV** | **Database Security** | | **12** | **20** |
| | 18 | Security requirements - integrity, confidentiality and availability of database | 2 | |
| | 19 | Reliability and integrity of database | 2 | |
| | 20 | Sensitive data, interface | 3 | |
| | 21 | Multilevel database | 2 | |
| | 22 | Proposals for multilevel database security | 3 | |
| **V** | **Open Ended Module** | | **12** | |

| | | |
|---|---|---|
| | **CASE STUDY: Administrating security**<br>Security planning –<br>Contents of a security planning, team members, commitment to a security plan, business continuity plans.<br>Risk analysis –<br>the nature of risk, steps of risk analysis. | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | 2 | - | - | 1 | 1 | | | | | | |
| CO2 | - | 3 | 1 | - | 1 | 1 | | | | | | |
| CO3 | - | 2 | 1 | - | 1 | 1 | | | | | | |
| CO4 | - | 2 | 1 | - | 1 | 1 | | | | | | |
| CO5 | 1 | 3 | 1 | - | 1 | 2 | | | | | | |
| CO6 | 1 | 2 | 1 | 1 | 1 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**Reference:**

1. C. P. Pfleeger and S. L. Pfleeger, Security in Computing, 4th Edition, Pearson India, ISBN: 9788131727256.

2. Matt Bishop, Computer Security: Art & Science, 1st Edition, Pearson, ISBN: 0201440997.

3. William Stallings, Cryptography and Network Security: Principles and Practice, 6th Edition, Pearson India, ISBN: 9332518777.

4. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, 4th Edition, Ceneage Learning India Pvt Ltd, ISBN: 8131516458.

## BCA8EJ406(2) - Parallel Computing

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA8EJ406(2) | | | | |
| Course Title | Parallel Computing | | | | |
| Type of Course | Elective | | | | |
| Semester | VIII | | | | |
| Academic Level | 400 - 499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Knowledge in Fundamentals of COA and Operating System | | | | |

| | |
|---|---|
| Course Summary | The syllabus is prepared with the view of preparing the BSc Computer Science Graduates to understand basic and advanced concepts of parallel computing. It covers Principles of Parallel Algorithm Design, Communication operations, Programming Using the Message Passing Paradigm, Programming Shared Address Space Platforms, Thread Basics, |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Summarize the key parallel computational models | U | C | Instructor-created exams / Quiz |
| CO2 | Appreciate and apply parallel and distributed algorithms in problem Solving | U | C | Instructor-created exams / Quiz |
| CO3 | Appreciate the communication models for parallel algorithm development | U | P | Instructor-created exams / Quiz |
| CO4 | Develop parallel algorithms using message passing paradigm | U | C | Instructor-created exams / Case studies |
| CO5 | Formulate parallel algorithms for shared memory architectures | U | P | Instructor-created exams / Quiz Case studies |
| CO6 | Understand thread management | U | P | Instructor-created exams / Quiz /Case studies |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

## Detailed Syllabus

| Module | Un it | Content | Hrs (48+12) | Marks |
|---|---|---|---|---|
| **I** | **Principles of Parallel Algorithm Design** | | **12** | **15** |
| | 1 | Parallel Processing platforms. Preliminaries, Decomposition Techniques, | 2 | |
| | 2 | Characteristics of Tasks and Interactions | 2 | |
| | 3 | Mapping Techniques for Load Balancing | 2 | |
| | 4 | Methods for Containing Interaction Overheads | 3 | |
| | 5 | Parallel Algorithm Models. | 3 | |
| **II** | **Communication Operations** | | **12** | **15** |
| | 6 | Basic Communication Operations - One-to-All Broadcast and All-to-One Reduction | 2 | |
| | 7 | All-to-All Broadcast and Reduction | 1 | |
| | 8 | All-Reduce and Prefix-Sum Operations | 3 | |
| | 9 | Scatter and Gather | 3 | |
| | 10 | All-to-All Personalized Communication, Circular Shift | 1 | |
| | 11 | Improving the Speed of Some Communication Operation | 2 | |
| **III** | **Programming Using the Message Passing Paradigm** | | **12** | **20** |
| | 12 | Principles of Message-Passing Programming, The Building Blocks: Send Operations | 2 | |
| | 13 | Receive Operations | 2 | |
| | 14 | MPI: The Message Passing Interface | 2 | |
| | 15 | Overlapping Communication with Computation | 2 | |
| | 16 | Collective Communication and Computation Operations | 2 | |
| | 17 | Groups and Communicators | 2 | |
| **IV** | **Programming Shared Address Space Platforms Thread Basics** | | **12** | **20** |
| | 18 | Thread Basics, Why Threads? The POSIX Thread Application Programme Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes | 2 | |
| | 19 | Thread Cancellation, Composite Synchronization Constructs | 2 | |
| | 20 | OpenMP: a Standard for Directive Based Parallel Programming, Specifying Concurrent Tasks in OpenMP | 3 | |
| | 21 | Synchronization Constructs in OpenMP | 2 | |

| | | | | |
|---|---|---|---|---|
| | 22 | OpenMP Applications: Parallel algorithm development for Matrix multiplication | 3 | |
| **V** | **Open Ended Module** | | **12** | |
| | **CASE STUDY: PARALLEL COMPUTING**<br>Heterogeneous Parallel Computing<br>Data parallel computing<br>Device Global Memory and Data Transfer<br>Kernel Functions and Threading | | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | 2 | - | - | - | - | | | | | | |
| CO2 | - | 2 | 1 | - | - | - | | | | | | |
| CO3 | - | 2 | 1 | - | 1 | 1 | | | | | | |
| CO4 | - | 2 | 1 | 1 | 1 | 2 | | | | | | |
| CO5 | - | 3 | 1 | 1 | - | 2 | | | | | | |
| CO6 | - | 2 | - | - | - | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | | ✓ | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO 6 | | | ✓ | |

**Reference:**

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, 2nd Ed, Addison-Wesley, 2003

2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 3rd Ed., Morgan Kaufman, 2016. References

3. Steven Brawer, Introduction to Parallel Computing, Academic Press, (1989)

4. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP: Portable Shared Memory Parallel Programming, MIT Press, 2008.

5. William Gropp, Ewing Lusk, Anthony Skjellum Using MPI: Portable Parallel Programming with the Message-Passing Interface, 3rd Ed, MIT Press, 2014.

# General Foundation Courses

# Multi-Disciplinary Course (MDC)

## BCA1FM 105 – Digital Marketing

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA1FM 105 | | | | |
| Course Title | Digital Marketing | | | | |
| Type of Course | MDC/MDE | | | | |
| Semester | I | | | | |
| Academic Level | 100-199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 3 | - | - | 45 |
| Pre-requisites | 1. Basic Computer Literacy<br>2. Familiarity with Online Platforms | | | | |
| Course Summary | This course provides students with a foundational understanding of key concepts and techniques in the rapidly evolving field of digital marketing. Through engaging lectures. Students will explore various digital marketing channels, including search engine optimization (SEO), social media marketing, email marketing, and content marketing. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To understand the concept of digital marketing and its integration with traditional marketing | U | C | Instructor-Create Exams or Quiz |
| CO2 | To understand customer value journey in digital context and behaviour of online consumers | A | P | Discussions and Quizzes |
| CO3 | To examine various tactics for enhancing a website's position and ranking with search engines | U | F | Instructor created exams or Home assignments |
| CO4 | To Identify and differentiate between various digital marketing channels, including SEO, social media, email, and content marketing. | A ,E | P | Discussions, Quizzes |
| CO5 | To get overall idea in implementing basic digital marketing strategies to enhance | Ap | P | Viva Voce Observation of |

| | | | | |
|---|---|---|---|---|
| | online visibility and engagement. | | | practical skills |
| CO6 | To get to know about ethical considerations and best practices in digital marketing, including privacy, data protection, and consumer trust | U | M | Instructor Created -Exams, Assignments |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (36+9) | Marks |
|---|---|---|---|---|
| **I** | **Digital Marketing Basics** | | **9** | **12** |
| | 1 | Overview of digital marketing | 2 | |
| | 2 | Importance of digital marketing for businesses | 2 | |
| | 3 | Introduction to key digital marketing channels (SEO, social media, email marketing) | 3 | |
| | 4 | Basics of creating a digital marketing strategy | 2 | |
| **II** | **Content Marketing & Social Media** | | **9** | **12** |
| | 5 | Content Marketing Fundamentals | 2 | |
| | 6 | Content Strategy Development | 2 | |
| | 7 | Content Creation for Different Platforms | 2 | |
| | 8 | Introduction to Social Media Marketing & keyword Optimization | 2 | |
| | 9 | Social Media Strategy & Community Management | 1 | |
| **III** | **Search Engine Optimization (SEO) & Paid Advertising** | | **9** | **14** |
| | 10 | Introduction to Search Engine Optimization | 2 | |
| | 11 | On-page and Off-page SEO Techniques | 2 | |
| | 12 | Search Engine Marketing (SEM) Fundamentals | 2 | |
| | 13 | Pay-Per-Click (PPC) Advertising with Google Ads | 2 | |
| | 14 | Social Media Advertising Platforms | 1 | |

| | | | | |
|---|---|---|---|---|
| **IV** | **Web Analytics & Emerging Trends** | | **9** | **12** |
| | 13 | Introduction to Web Analytics & Key Metrics | 2 | |
| | 14 | Using Analytics Tools for Data-Driven Decision Making | 2 | |
| | 15 | Conversion Tracking & Optimization | 2 | |
| | 16 | Emerging Trends in Digital Marketing | 2 | |
| | 17 | The Future of Marketing | 1 | |
| **V** | **Hands-on: Practical Applications, Case Study and Course Project** | | **9** | |
| | 1 | **S**ocial Media Marketing-Social media Channels | 2 | |
| | 2 | Leveraging social media for brand conversions and buzz | 2 | |
| | 3 | Recent trends in digital marketing | 3 | |
| | 4 | Demonstrate how to use google web masters Indexing Using API | 2 | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | ✓ | | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO6 | | | | ✓ |

**References:**

1. DeWald, R. (2021). Digital Marketing for Dummies.
2. Kotler, P., Kartajaya, H., & Setiawan, I. (2017). Marketing 4.0: Moving from

Traditional to Digital.

3. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation. Kogan Page Limited.
4. Kumar, S., & Kaur, S. (2020). Digital Marketing. Taxmanns.
5. Hill, R. (2024). Social Media Marketing 2024: Mastering New Trends & Strategies for Online Success.

# Value-Added Course (VAC)

## BCA4FV108 – Introduction to Cyber Laws

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA4FV108 | | | | |
| Course Title | Introduction to Cyber Laws | | | | |
| Type of Course | VAC | | | | |
| Semester | IV | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 3 | - | - | 45 |
| Pre-requisites | 1. Basic Computer Literacy<br>2. Familiarity with Online Platforms | | | | |
| Course Summary | Introduction to Cyber laws provides students with a foundational understanding of various concepts Cyber Crimes and Cyber laws against them. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | To understand the concept of Cyber Space, Cyber Crimes and cyber laws | U | C | Instructor-Create Exams or Quiz |
| CO2 | To understand details of cybercrimes and criminals | A | P | Discussions and Quizzes |
| CO3 | To examine various provisions in IT Act 2000 | U | F | Instructor created exams or home assignments |
| CO4 | To Identify Intellectual Property right and E-commerce related issues. | A, E | P | Discussions, Quizzes |

| | | | | |
|---|---|---|---|---|
| CO5 | To get overall idea of cyber laws and its enforcement mechanisms in India | Ap | P | Viva Voce Observation of practical skills |
| CO6 | To get to know about Penalties and legal implications associated with cybercrimes under Indian law | U | M | Instructor Created - Exams, Assignments |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (36+9) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Cyber Space** | | **9** | **12** |
| | 1 | Cyber Space- Fundamental definitions | 2 | |
| | 2 | Jurisprudence and-Jurisdiction in Cyber Space | 2 | |
| | 3 | Need for IT act - Enforcement agencies | 3 | |
| | 4 | Introduction to cyber law and its relevance in the Indian context | 2 | |
| **II** | **Cyber Crimes and Criminals** | | **9** | **12** |
| | 5 | Cyber crimes | 2 | |
| | 6 | Cyber Criminals and their Objectives | 2 | |
| | 7 | Cyber stalking; cyber pornography | 2 | |
| | 8 | Forgery and fraud; crime related to IPRs; | 2 | |
| | 9 | Phishing and Identity Theft | 1 | |
| **III** | **Indian Cyber law** | | **9** | **14** |
| | 10 | Introduction to Indian Cyber Law | 2 | |
| | 11 | Cyber Crime vs Conventional Crime | 2 | |
| | 12 | Electronic Commerce and related issues | 2 | |
| | 13 | Overview of Intellectual Property rights | 2 | |
| | 14 | Computer Software and related IPR Issues | 1 | |
| **IV** | **Basics of IT law and its regulatory mechanisms** | | **9** | **12** |

| | | | | |
|---|---|---|---|---|
| | 13 | Key provisions of the Information Technology Act, 2000 related to cybercrimes and offenses | 2 | |
| | 14 | Regulatory Mechanisms and Enforcement | 2 | |
| | 15 | Overview of the Cyber Crime Investigation Cell (CCIC) | 2 | |
| | 16 | Understanding the process of reporting cyber crimes | 2 | |
| | 17 | Penalties and legal implications associated with cybercrimes under Indian law (basics only) | 1 | |
| **V** | **Hands-on: Practical Applications, Case Study and Course Project** | | **9** | |
| | 1 | **S**ocial media based Cyber crimes | 2 | |
| | 2 | Discussion on Emerging issues | 2 | |
| | 3 | Recent trends in digital marketing | 3 | |
| | 4 | Demonstrate how to use google web masters Indexing Using API | 2 | |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | ✓ | | | ✓ |
| CO 5 | | ✓ | | ✓ |
| CO6 | | | | ✓ |

**References:**

1. Cyber law –The Indian perspective by Pavan Duggal
2. Justice Yatindra Singh: Cyber Laws, Universal Law Publishing Co., New Delhi
3. Farouq Ahmed, Cyber Law in India, New Era publications, New Delhi

## BCA6FV110– Business Intelligence and Innovation

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA6FV110 | | | | |
| Course Title | Business Intelligence and Innovation | | | | |
| Type of Course | VAC | | | | |
| Semester | VI | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 3 | - | - | 45 |
| Pre-requisites | 1. Basic Understanding of Business Operations.<br>2. Foundational Knowledge of Data Analysis.<br>3. Awareness of IT Infrastructure | | | | |
| Course Summary | This course offers a comprehensive exploration of Business Intelligence (BI), IT innovation, and startup culture. It covers fundamental concepts, tools, and strategies essential for navigating the modern business landscape. Students delve into the importance of data-driven decision-making and learn about data collection, analysis, and visualization techniques. Additionally, the course delves into the dynamics of innovation ecosystems, lean startup methodologies, and funding strategies for entrepreneurial ventures. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Acquire a comprehensive understanding of Business Intelligence and its applications | Ap | C | Instructor-Create Exams or Quiz |
| CO2 | Students can implement data-driven decision-making processes in various business contexts. | E | C | Discussions and Quizzes |
| CO3 | Develop customised Business Intelligence solutions tailored to specific organisational needs. | Ap | C | Instructor created exams or home assignments |
| CO4 | Evaluate emerging trends and technologies in IT for potential business impact. | Ap | C | Discussions, Quizzes |
| CO5 | Lead entrepreneurial initiatives by applying lean startup methodologies and securing | Ap | C | Viva Voce Observation of practical skills |

| | | | | |
|---|---|---|---|---|
| | funding. | | | |
| CO6 | Analyse case studies of successful IT innovations for practical insights and application. | Ap | C | Instructor Created -Exams, Assignments |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (36+9) | Marks |
|---|---|---|---|---|
| I | **Introduction to Business Intelligence (BI)** | | **9** | **10** |
| | 1 | Overview of Business Intelligence concepts, Business Intelligence technologies | 2 | |
| | 2 | Importance of Business Intelligence in Decision-making Processes | 2 | |
| | 3 | Data-driven decision-making (Data Collection, Data Integration, Data Analysis, Data Visualisation, Decision Support), Benefits of Data-Driven Decision Making | 2 | |
| | 4 | Tools and techniques for data collection, processing, and analysis | 3 | |
| II | **Exploring BI Tools and Applications** | | **9** | **15** |
| | 5 | Application of Business Intelligence in different business domains | 2 | |
| | 6 | Business Intelligence tools for Performance Monitoring (Tableau, Power BI, Qlik Sense, IBM Cognos Analytics, Oracle BI) | 3 | |
| | 7 | Use of Business Intelligence tools for performance monitoring | 2 | |
| | 8 | Data visualization techniques | 2 | |
| III | **IT Entrepreneurship and Startup Culture** | | **9** | **15** |
| | 9 | Innovation in IT and Startup Culture, Understanding Innovation Ecosystems | 2 | |
| | 10 | Startup culture and lean startup methodology, Identifying opportunities for innovation in IT | 2 | |
| | 11 | Funding for Startups and Entrepreneurial Ventures, Sources of funding for startups | 2 | |
| | 12 | Venture capital investment process, Bootstrapping strategies | 1 | |
| | 13 | Financial modelling and valuation techniques, Legal and regulatory considerations | 2 | |
| **IV** | **IT Innovation: Trends, Successes, and Challenges** | | **9** | **10** |

| | | | | |
|---|---|---|---|---|
| | 14 | Innovations in IT, Entrepreneurial mindset and skills development | 2 | |
| | 15 | Emerging trends and technologies in IT | 2 | |
| | 16 | Case studies of successful IT innovations in India (Infosys, Tata Consultancy Services (TCS), Wipro Limited, HCL Technologies, Zoho Corporation) | 3 | |
| | 17 | Opportunities and challenges in adopting innovative technologies, Strategies for managing technological change. | 2 | |
| **V** | **Open Ended Module- Application Level** | | **9** | |
| | | Discuss from the following:<br>• Strategic Role of Business Intelligence.<br>• Next-generation Data Visualization Techniques and Tools.<br>• Understanding Innovation Ecosystems.<br>• Agile Methodologies and Lean Startup Principles for IT Innovation.<br>• Ethical Considerations in Data-driven Decision-making and Innovation<br>• Future Outlook: Anticipating Trends and Staying Ahead of the Curve | **9** | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | 2 | 1 | - | - | | | | | | |
| CO 2 | 1 | 1 | 2 | 1 | - | - | | | | | | |
| CO 3 | - | 3 | 1 | 1 | - | - | | | | | | |
| CO 4 | - | 3 | 3 | 2 | - | - | | | | | | |
| CO 5 | - | 1 | 3 | 3 | 1 | - | | | | | | |
| CO 6 | - | 1 | 3 | 3 | 1 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |

| | |
|---|---|
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**Reference:**

1. Business Intelligence Guidebook: From Data Integration to Analytics by Rick Sherman.
2. Business Intelligence: A Managerial Perspective on Analytics by Ramesh Sharda, Dursun Delen, and Efraim Turban.
3. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling by Ralph Kimball and Margy Ross.
4. Lean Analytics: Use Data to Build a Better Startup Faster" by Alistair Croll and Benjamin Yoskovitz.
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
6. Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist" by Brad Feld and Jason Mendelson.
7. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company" by Steve Blank and Bob Dorf.

# Skill Enhancement Course (SEC)

## BCA1FS111– Introduction to Computers and Office Automation

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA1FS111 | | | | |
| Course Title | Introduction to Computers and Office Automation. | | | | |
| Type of Course | SEC | | | | |
| Semester | I | | | | |
| Academic Level | 100-199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 3 | - | - | 45 |
| Pre-requisites | Basic knowledge of computers & Internet. | | | | |
| Course Summary | This course focuses on the use of computer technology and software applications to automate routine office tasks and streamline business processes. Students will be able to use computer technology to enhance communication and data management. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Understand the fundamentals of computer Hardware and Software and Computer Networks. | U | C | Instructor-created exams / Quiz/ Assignment/ Seminar |
| CO2 | Understand the fundamentals of word processing and its importance in office automation. Demonstrate proficiency in creating, editing, and formatting documents using word processing software. Explore advanced formatting options and features | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO3 | Understand the fundamentals of electronic spreadsheets and their role in data analysis, manipulation, and presentation. Demonstrate proficiencyin creating, saving, and editing workbooks and worksheets within electronic spreadsheet software. Utilize various data entry techniques. Handle operators in formulas and utilize a wide range of functions. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |

| | | | | |
|---|---|---|---|---|
| CO4 | Demonstrate proficiency in creating, manipulating, and enhancing slides within presentation software, including adding text, images, shapes, and multimedia elements. Expertise in utilizing organizational charts and various chart types to represent hierarchical structures and data trends effectively. Explore drawing tools to create custom shapes, diagrams, and illustrations. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | To empower students to design and implement automation solutions inreal-world scenarios. | Ap | P | Case study/ Project |
| CO6 | Gaining a deep understanding of emerging trends and technologies inthe field of automation. | U, Ap | P | Assignment/ Seminar |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (36+9) | Marks |
|---|---|---|---|---|
| **I** | | **Introduction To Computers** | **8** | **14** |
| | 1 | Types of Computers | 1 | |
| | 2 | Hardware: CPU, Input/Output Devices. Storage Devices, memory hierarchy, RAM, ROM, Secondary Memory,and Registers. | 3 | |
| | 3 | Software: Types of Software, computer languages, language translators, and Operating Systems. | 2 | |
| | 4 | Computer Networks: LAN, WAN, MAN, Client -Server | 2 | |
| **II** | | **Documentation Using a Word Processor (OpenOffice Writer / M.S. Word)** | **8** | **12** |
| | 5 | Introduction to Office Automation, Word Processing Concepts - creating and editing documents, Formatting documents. | 3 | |
| | 6 | Finding and Replacing Text, Printing documents, Auto-text, Autocorrect, Spelling and Grammar Tools. | 2 | |
| | 7 | Document Dictionary, Graphics, Tables, Charts, Columns, Page Borders, Bookmark. | 1 | |
| | 8 | Advanced Features- Mail Merge, Macros, Tables, File Management, Printing, Styles, linking and embedding objects, Template. | 2 | |
| **III** | | **Electronic Spread Sheet (Open Office Calc/MS- Excel)** | **10** | **12** |
| | 9 | Introduction to Spread Sheet, Spreadsheet Concepts, Creating, Saving, and Editing a Workbook. | 2 | |
| | 10 | Inserting, deleting worksheets, entering data in a Cell/Formula, Copying and moving data from selected Cells. | 1 | |

| | | | | |
|---|---|---|---|---|
| | 11 | Handling Operators in Formula. Functions: Mathematical, Logical, Statistical, Text, Financial, Date and Time, Function Wizard. | 1 | |
| | 12 | Formatting a Worksheet, Formatting Cells, and Changing Data alignments. Changing date, Character, Number, Currency format, Changing font. | 2 | |
| | 13 | Adding borders and colors, Printing Worksheets, Charts and graphs, creating previewing and modifying charts, Conditional Formatting, and Filters. | 3 | |
| | 14 | Advanced features – Pivot table & Pivot Chart, Linking and Consolidation | 1 | |
| **IV** | **Presentation using (OpenOffice Impress/MS- Power Point)** | | **10** | **12** |
| | 15 | Presentations, Creating, Manipulating & Enhancing Slides. | 2 | |
| | 16 | Organizational Charts, Charts, Drawing objects, clip arts, Word Art, Layering art Objects. | 4 | |
| | 17 | Inserting Animated Pictures or Accessing through Object, Inserting Recorded Sound Effect or In-Built Sound Effect. | 4 | |
| **V** | **Open Ended Module** | | **9** | |
| | 1 | • Design and Implement Automation Solutions in real-world scenarios<br>• Understand Future Trends in Automation | 9 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | - | - | - | - | | | | | | |
| CO 2 | 3 | 2 | - | - | 3 | - | | | | | | |
| CO 3 | 3 | 2 | - | - | 3 | - | | | | | | |
| CO 4 | 3 | 2 | - | - | 3 | - | | | | | | |
| CO 5 | 3 | 1 | - | - | 3 | - | | | | | | |
| CO 6 | 3 | 1 | - | - | 3 | 3 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam

- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**


1. P. K. Sinha and P. Sinha, "Foundations of Computing". BPB Publicaiion.
2. Russell A. Stultz, Learn Microsoft Office, BPB Publication.
3. S. Sagman. "Microsoft Office 2000 for Windows". Pearson Education.
4. Turban, Mclean and Wetherbe. "Information Technology and Management John Weily and Sons.
5. H.M.Deitel, P. J. Deitel, et al., Internet & World Wide Web - How to program, Prentice Hall.


## BCA2FS112 – Data Analysis using Spread Sheet

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA2FS112 | | | | |
| Course Title | Data Analysis using Spread Sheet | | | | |
| Type of Course | SEC | | | | |
| Semester | II | | | | |
| Academic Level | 100-199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 2 | - | 2 | 60 |
| Pre-requisites | 1. Familiarity with Spreadsheet Software. | | | | |

| | |
|---|---|
| | 2. Understanding of Basic Mathematical and Statistical Concepts |
| Course Summary | After completing the course, students have a solid foundation in data analysis using spreadsheets, empowering them to analyze data with confidence, derive meaningful insights, and communicate their findings effectively to stakeholders. |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Students will demonstrate proficiency in managing spreadsheets, including creating, formatting, and manipulating data within workbooks. They will be able to effectively navigate the spreadsheet interface and utilize toolbars. | Ap | P | Instructor-Create Exams or Quiz |
| CO2 | Learners will understand the importance of data organization and cleansing in spreadsheets. They will be able to import, export, filter, sort, validate, and remove duplicates from datasets. Students will develop skills to ensure data integrity and consistency, enhancing their ability to work with clean and organized datasets. | U | C | Discussions and Quizzes |
| CO3 | Participants will acquire advanced data analysis skills like pivot tables, what-if analysis, and goal seek. They will be able to apply various spreadsheet functions and tools to perform complex calculations, analyze trends, and make informed decisions based on data analysis. | An | P | Instructor created exams or Home assignments |
| CO4 | Students will gain proficiency in data visualization techniques using spreadsheets. They will be able to create a variety of charts, design pivot charts, and dashboards for effective data analysis. | C | P | Discussions, Quizzes |
| CO5 | Learners will be able to implement form controls for interactive data manipulation in their visualizations, enhancing their ability to present and explore data dynamically. | Ap | P | Viva Voce Observation of practical skills |
| CO6 | Learners will develop skills in advanced features of spreadsheets such as macros, protecting data sheets and workbooks, utilizing split, freeze, and hide options | C | P | Instructor Created -Exams, Assignments |

| | | | | |
|---|---|---|---|---|
| | effectively. They will also learn to incorporate add-ins for extended functionalities and manage printing options for the professional presentation of data. | | | |

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

**Detailed Syllabus**

| Module | Unit | Content | Hrs (30+30) | Marks |
|---|---|---|---|---|
| I | | **Introduction to Spreadsheet** | **7** | **10** |
| | 1 | Overview of spreadsheet software (e.g., Microsoft Excel, Google Sheets), Basic spreadsheet navigation and interface | 1 | |
| | 2 | Entering and formatting data, Data types and cell formatting, Sorting and filtering data | 2 | |
| | 3 | Arithmetic operations and basic formulas, Common functions (SUM, AVERAGE, MIN, MAX, COUNT) | 2 | |
| | 4 | Text functions (CONCATENATE, LEFT, RIGHT, MID, TEXT), Date and time functions | 2 | |
| II | | **Data Cleaning and Visualization** | **8** | **15** |
| | 5 | Logical functions (IF, AND, OR, NOT, IFERROR, IFS, SWITCH), Lookup and reference functions (VLOOKUP, HLOOKUP, INDEX, MATCH) | 2 | |
| | 6 | Financial functions (NPV, IRR, PMT), Array formulas (SUMPRODUCT, SUMIF, AVERAGE, TRANSPOSE, Array Multiplication, FILTER, IMPORTRANGE) | 2 | |
| | 7 | Handling missing values and duplicates, Data transformation techniques (text to columns, merging cells) | 2 | |
| | 8 | Using advanced text functions for data cleaning, Data validation rules and error-checking | 1 | |
| | 9 | Creating and customizing charts (bar, line, pie, scatter, Histogram), Conditional formatting for data visualization | 1 | |
| III | | **Pivot Tables and Pivot Charts** | **8** | **10** |
| | 10 | Sparklines and data bars, Advanced chart techniques (combination charts, dual-axis charts) | 2 | |
| | 11 | Creating and configuring pivot tables, Grouping and summarizing data in pivot tables | 2 | |

| | | | | |
|---|---|---|---|---|
| | 12 | Creating and customizing pivot charts | 2 | |
| | 13 | Using slicers and timeline for interactive analysis | 2 | |
| **IV** | **Data Analysis Technique** | | **7** | **15** |
| | 14 | Descriptive statistics (mean, median, mode, standard deviation) | 1 | |
| | 15 | Correlation and regression analysis with example, Data analysis tools (Solver, Analysis ToolPak) | 2 | |
| | 16 | Scenario analysis and what-if analysis (Goal Seek, Data Tables, Scenario Manager) | 2 | |
| | 17 | Introduction to DAX (Data Analysis Expressions) for complex calculations (Concept Only) | 2 | |
| **V** | **Practical Applications** | | **30** | |
| | 1 | 1. Implement filter and sort operations.<br><br>2. Perform basic Arithmetic operations (Sum, Difference, Product, Divides)<br><br>3. Using a dataset of student grades in different subjects, calculate the average grade, highest grade (MAX), lowest grade (MIN), and the total number of grades recorded (COUNT).<br><br>4. Create a spreadsheet with a list of full names in one column. Use text functions to separate the first names and last names into two new columns.<br>5. Create a spreadsheet with a list of dates of birth and names. Using the appropriate date and time functions, calculate each person's current age.<br><br>6. Perform Logical function on a given dataset.<br><br>7. Using a dataset of students' information, create a bar chart to visualize the data. Customize the chart with titles, axis labels, and different colours for each bar.<br><br>8. A list of 15 students with their hours of study per week and their corresponding exam scores, Use the CORREL function to Calculate the correlation coefficient. | **7** | |

| | | | | |
|---|---|---|---|---|
| | | 9. Perform a simple linear regression to determine the relationship between advertising spend and sales.<br><br>10. Implement any one real life example. | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | - | 2 | 1 | - | - | | | | | | |
| CO 2 | 1 | - | 2 | 1 | - | - | | | | | | |
| CO 3 | 1 | - | 1 | 1 | - | - | | | | | | |
| CO 4 | 2 | - | 3 | 2 | - | - | | | | | | |
| CO 5 | 2 | - | 3 | 3 | 1 | - | | | | | | |
| CO 6 | 1 | - | 3 | 3 | 1 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**


1. Alexander, M., Kusleika, R., & Walkenbach, J. (2018). Excel 2019 Bible. Wiley.
2. Winston, W. (2019). Microsoft Excel Data Analysis and Business Modeling. Microsoft Press.
3. Nigam, M. (2021). Data Analysis with Excel: Tips and Techniques. BPB Publications.
4. Alexander, M., & Kusleika, D. (2018). Excel 2019 Power Programming with VBA. Wiley.
5. McFedries, P. (2019). Excel Pivot Tables and Pivot Charts: Your visual blueprint for creating dynamic spreadsheets. Visual.


## BCA3FS113 – Website Designing using Content Management System

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA3FS113 | | | | |
| Course Title | Website Designing using Content Management System | | | | |
| Type of Course | SEC | | | | |
| Semester | III | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 2 | - | 2 | 60 |
| Pre-requisites | 1. Familiarity with web content management systems (CMS).<br>2. Basic knowledge of internet technologies provides a foundation for learning web design. | | | | |
| Course Summary | The course covers fundamental web design concepts including HTML and CMS principles, focusing on Drupal as a robust Content Management System. Students will learn to create and customize websites using Drupal, exploring its features such as content types, themes, and modules to build dynamic and interactive web pages. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Cultivate a robust understanding of web design fundamentals, laying a strong | U | C | Assignment / Instructor- |

| | | | | |
|---|---|---|---|---|
| | foundation for their journey into the dynamic world of digital design and development. | | | created exams / Quiz |
| CO2 | Attain comprehensive knowledge and practical proficiency in Content Management Systems (CMS), empowering to navigate and excel in the ever-evolving landscape of digital content creation and management. | U | C | Assignment / Instructor-created exams / Quiz |
| CO3 | Develop expertise in Drupal, a widely used CMS platform, gaining comprehensive understanding of its features, configuration, and installation processes, thus preparing them for proficient and innovative web development endeavors. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO4 | Impart a comprehensive understanding of website development using Drupal and facilitate the acquisition of expertise across various options within the Drupal ecosystem. | Ap | P | Practical Assignment / Instructor-created exams / Quiz |
| CO5 | Gain an understanding of how to apply web design concepts to real-world scenarios, effectively designing and developing functional and aesthetically pleasing websites utilizing the Drupal CMS. | C | P | Practical Assignment / Instructor-created exams / Quiz |
| CO6 | Develop proficiency in advancedwebsite management skills, including installing and configuring modules, managing menus, and more, to effectively navigate and optimize the functionality of websites built on the Drupal platform. | C | P | Practical Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (30+30) | Marks |
|---|---|---|---|---|
| **I** | **Introduction to Web Designing** | | **6** | **10** |
| | 1 | Basics of Web Designing -World Wide Web (WWW), W3C, Web Browser | 1 | |
| | 2 | Web Server, Web Hosting, Web Pages, DNS, URL | 2 | |
| | 3 | Overview of HTML (Concept only) and its role in Web Development | 1 | |
| | 4 | Open-Source S/W, Open-Source vs Closed Source Software, Open | 2 | |

| | | | | |
|---|---|---|---|---|
| | | Source Licenses (Concept only) | | |
| **II** | **Introduction to CMS** | | **6** | **10** |
| | 5 | Introduction to Content Management Systems (CMS) - Features of CMS | 2 | |
| | 6 | Web Content Management System | 2 | |
| | 7 | Components of Content Management System | 2 | |
| **III** | **Introduction to Drupal** | | **8** | **15** |
| | 8 | Drupal - Features, Advantages and Disadvantages, Installation and Configuration | 2 | |
| | 9 | Content types and Field<br>Drupal Architecture | 2 | |
| | 10 | User Management, Managing Comments | 2 | |
| | 11 | Creating and Customizing Themes | 2 | |
| **IV** | **Building Website** | | **10** | **15** |
| | 12 | Website Development - Working with Templates and Template files | 2 | |
| | 13 | Articles, Creating Web Forms | 1 | |
| | 14 | Managing blocks, Add Links to Blocks, Moving Elements within Block | 2 | |
| | 15 | Blocks and Regions | 1 | |
| | 16 | Creating and Customizing Views, Installing and Configuring Modules | 2 | |
| | 17 | Static Pages, Creating Pages, Menu Management. | 2 | |
| **V** | **Practical** | | **30** | |
| | | 1. Install and configure Drupal on your computer.<br>2. Design a website of your college using Drupal and modify the basic site settings.<br>3. Add different menus to your website. The menus should contain: home, news, gallery, about us and contact us.<br>4. Create user roles for your site and assign permissions.<br>5. Install and activate a new theme from the Drupal theme repository.<br>6. Add different blocks in to your website.<br>7. Create a new content type and add some fields to it.<br>8. Add new article to your site.<br>9. Install and configure the 'pathauto' module.<br>10. Create the mobile view of your website. | 30 | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | 1 | 1 | 3 | 1 | | | | | | |
| CO 2 | 1 | 3 | 2 | 1 | 3 | 1 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 3 | 1 | 3 | 1 | 1 | 3 | 2 | | | | | | |
| CO 4 | 1 | 3 | 3 | 1 | 3 | 2 | | | | | | |
| CO 5 | 3 | 3 | 3 | 1 | 3 | 2 | | | | | | |
| CO 6 | 1 | 3 | 3 | 1 | 3 | 2 | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**References:**

1. Jennifer Campbell, Jennifer T Campbell, Web Design: Introductory, Course Technology.

2. Jason Beaird and Alex Walker, The Principles of Beautiful Web Design, SitePoint.

3. Bob Boiko, Content Management Bible, Wiley.

4. Daniel Sipos, Drupal 9 Module Development, Packt Publishing Limited.

# BCA5FS114 – Professional Skill Development for IT Career Excellence

| | | | | | |
|---|---|---|---|---|---|
| Programme | BCA | | | | |
| Course Code | BCA5FS114 | | | | |
| Course Title | Professional Skill Development for IT Career Excellence | | | | |
| Type of Course | SEC | | | | |
| Semester | V | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours |
| | 3 | 3 | - | - | 45 |
| Pre-requisites | 1. Basic Mathematics<br>2. Basic English reading and Writing Skills | | | | |
| Course Summary | The course provides a comprehensive overview of essential skills and knowledge relevant to success in information technology. It covers various topics, including personal development, communication, quantitative reasoning, programming, software development, and web technologies. | | | | |

**Course Outcomes (CO):**

| CO | CO Statement | Cognitive Level* | Knowledge Category# | Evaluation Tools used |
|---|---|---|---|---|
| CO1 | Students will demonstrate effective communication skills, including verbal and written communication, and adhere to professional etiquette standards in various contexts, including digital communication. | Ap | C | Assignment / Instructor-created exams / Quiz |
| CO2 | Students will develop job readiness skills, including resume writing, job application preparation, and interview techniques, to enhance their employability and succeed in job interviews. | E | C | Assignment / Instructor-created exams / Quiz |
| CO3 | Students will collaborate effectively in group discussions and presentations, demonstrating teamwork, leadership, and critical thinking skills in diverse group settings. | Ap | C | Assignment / Instructor-created exams / Quiz |
| CO4 | Students will apply quantitative and logical reasoning skills to solve mathematical problems, analyse data, and make informed decisions in various contexts, including financial and analytical reasoning. | Ap | C | Assignment / Instructor-created exams / Quiz |
| CO5 | Students will understand fundamental programming concepts, data | Ap | C | Assignment / Instructor- |

| | | | | |
|---|---|---|---|---|
| | structures, and database principles, and apply them to solve computational problems and develop software applications. | | | created exams / Quiz |
| CO6 | The student will be able to learn areas and skills essential for success in the IT industry, including communication, problem-solving, programming, and technology integration. | Ap | C | Assignment / Instructor-created exams / Quiz |
| * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)<br># - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) | | | | |

**Detailed Syllabus**

| Module | Unit | Content | Hrs (36+9) | Marks |
|---|---|---|---|---|
| I | **Introduction to Soft Skills and Academic Skills** | | **10** | **15** |
| | 1 | Personality Development: Knowing Yourself, Positive Thinking, Communication Skills, Professional Etiquette | 2 | |
| | 2 | Employment Communication: Introduction, Resume, Curriculum Vitae, Developing an Impressive Resume, Job Application or Cover Letter | 2 | |
| | 3 | Job Interviews: Definition of Interview, Types of Interviews, Preparatory Steps for Job Interviews, Interview Skill Tips | 2 | |
| | 4 | Group Discussion: Importance of Group Discussions, Difference between Group Discussion, Panel Discussion and Debate, Preparing the Presentation, Delivering the Presentation | 2 | |
| | 5 | HR round: Self Introduction, Strength and Weakness Analysis, Scenario-Based Tasks, Body Language, Positive Attitude | 2 | |
| II | **Basic Aptitude Skills** | | **9** | **15** |
| | 6 | Number System: HCF and LCM, Decimal Fraction, Problems on Age | 2 | |
| | 7 | Square Root, Cube Root, Problems on Numbers, | 1 | |
| | 8 | Problems on Speed, Time and Distance, Percentage, Problems on Trains | 2 | |
| | 9 | Profit and Loss, Ratio and Proportion, Partnership | 2 | |
| | 10 | Simple Interest, Compound Interest, Chain Rule, Problems on Callender and Clock | 2 | |
| | **Reasoning Skills Development** | | **9** | **10** |

| | | | | |
|---|---|---|---|---|
| **III** | 11 | Verbal Reasoning: Antonym and Synonym, Verbal Analogies, Spotting Errors, Ordering Words, Sentence correction, Fill in blanks, Replace the word, Idioms and Phrases | 3 | |
| | 12 | Logical Reasoning Aptitude: Series: Missing Numbers, Odd One Out, Assumptions and Conclusions, Alpha-Numeric Sequence Puzzle, Number, Ranking & Time Sequence Test | 3 | |
| | 13 | Non-Verbal Reasoning: Choosing the Missing Figure in a Series, Choosing the Set of Similarly Related Figures, Dot Situation, Basic Analytical Reasoning | 3 | |
| **IV** | **Technical Skills and Programming Skills** | | **8** | **10** |
| | 14 | Concept of Procedure-Oriented Programming and Object-Oriented Programming, Basic structure of C Programming | 2 | |
| | 15 | Data Structures: Array, Linked list, Stack, Queue, Tree and Graphs (Concept Only) | 2 | |
| | 16 | Database Concept: ER Model, Normalisation, ACID Property, DML and DDL | 2 | |
| | 17 | Basic Concept of SDLC, Agile Model(Concept Only), Blackbox and Whitebox Testing(Concept) | 2 | |
| **V** | **Open Ended Module- Application Level** | | **9** | |
| | | Assign the tasks from the following<br>• Writing an impressive resume<br>• Active listening and feedback mechanisms<br>• Conduct Ice breaking Session<br>• Assign students to participate in a group discussion on a given topic and write a reflective analysis of their experience, including observations on communication dynamics, collaboration, and leadership.<br>• Pair students and assign roles (interviewer and interviewee) to conduct mock interviews based on various scenarios, such as behavioural questions, technical challenges, or situational inquiries.<br>• Task students with designing and delivering a professional presentation on a topic related to their field of study or interest, incorporating effective visual aids, storytelling techniques, and audience engagement strategies.<br>• Conduct low-level Aptitude tests, including Verbal and Non-Verbal Reasoning.<br>• Conduct high-level Aptitude tests, including Verbal and Non-Verbal Reasoning.<br>• Writing Simple programming in any language.<br>• Assign students to research and analyse a real-world software development project, applying | | |

| | | | | |
|---|---|---|---|---|
| | | concepts of the Software Development Life Cycle (SDLC) | | |

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | 2 | 1 | - | - | | | | | | |
| CO 2 | 1 | 1 | 2 | 1 | - | - | | | | | | |
| CO 3 | - | 3 | 1 | 1 | - | - | | | | | | |
| CO 4 | - | 3 | 3 | 2 | - | - | | | | | | |
| CO 5 | - | 1 | 3 | 3 | 1 | - | | | | | | |
| CO 6 | - | 1 | 3 | 3 | 1 | - | | | | | | |

**Correlation Levels:**

| Level | Correlation |
|---|---|
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- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Practical Evaluation | End Semester Examinations |
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| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | ✓ | | ✓ |
| CO 3 | ✓ | ✓ | | ✓ |
| CO 4 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 5 | ✓ | ✓ | | ✓ |
| CO 6 | ✓ | ✓ | | ✓ |

**Reference:**


1. Chauhan, G. S., & Sharma, S. (2016). Soft Skills: An Integrated Approach to Maximise Personality. Wiley India.
2. Sonmez, J. (2015). Soft Skills: The Software Developer's Life Manual. Manning Publications.
3. Mitra, B. K. (2011). Personality Development and Soft Skills. Oxford University Press.
4. Aggarwal, R. S. (2017). Quantitative Aptitude for Competitive Examinations. S. Chand Publishing.
5. Verma, R. (2018). Fast Track Objective Arithmetic. Arihant Publications.
6. Aggarwal, R. S. (2018). A Modern Approach to Verbal and Non-Verbal Reasoning. S. Chand Publishing.
7. Rizvi, M. A. (2005). Effective Technical Communication. Tata McGraw-Hill Publishing.

Name……..

Reg. No……

# FIRST SEMESTER B.C.A DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION

# NOVEMBER 2024

**(SHFYUGP)**

## BCA1CJ103/BCA1MN 102 - Discrete Structures for Computer Applications

CREDITS : 4

(2024 admission onwards)

Time : Two Hours Maximum : 70 Marks

**SECTION A** (Short Answer) Answer **all** questions

Each question carries **3** Mark

Overall ceiling 24 Mark

1. Explain the term Tautology with truth table.
2. Summarize Propositional Logic
3. Compare the difference between Injective and Surjective Function.
4. Find the union, intersection and difference of A and B. A = {1, 2, 3, 4, 5, 7, 9}
   B = {3, 4, 5, 6, 8, 10, 11}
5. What is the difference between a Simple graph and Multi graph.
6. Compare Cut-set and Cut-vertices.
7. Define a Regular graph. Give an example.
8. Define Homeomorphism.
9. Draw a Venn diagram to find A ∩ B, A – B given A = {1,2,3,4,5,6,7} and B = {3, 5,7,9,11}.
10. Explain a Tree with properties.

( 8 x 3 = 24 Mark )

**SECTION B** (Short Essay) Answer **all** questions

Each question carries **6** Mark

Overall ceiling 36 Mark

11. Summarize TSP with example
12. Prove: ¬ [P ∨ (¬P ∧ Q) ] ≡ ¬P ∧ ¬ Q using laws.

13. Explain Basic Theorems on Tress.

14. Construct a Truth table for $(\sim P \vee Q) \rightarrow (P \rightarrow \sim Q)$.

15. Find $(f \circ g)(x)$ and $(g \circ f)(x)$. if $f(x) = x^2$ $g(x) = 2x + 1$.

16. Justify your answer, The given Relation is Reflexive, Symmetric, or Transitive.
A = {2, 3, 4} R = {(2, 2), (3, 3), (4, 4), (2, 3), (3, 4), (3, 2), (4, 3), (2, 4)}

17. Explain Hamiltonian graph with example

18. Define Kruskal's Algorithm with example

( 6 x 6= 36 Mark )

**SECTION C** (Essay) Answer any **One** questions
Each question carries **10** Mark

19. Illustrate Logical Equivalences.

20. Summarize Graph and its types

( 1 x 10= 10 Mark )

Name……...

Reg.No…….

# FIRST SEMESTER B.C.A DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION

# NOVEMBER 2024

(SHFYUGP)

BCA1CJ102/BCA1MN 101- Mathematical Foundation for Computer Applications

CREDITS: 4

(2024 admission onwards)

Time: Two Hours Maximum: 70 Marks

**SECTION A** (Short Answer) Answer all questions
Each question carries **3** Mark

Overall ceiling 24 Mark

1. Define Determinants with an example.
2. Illustrate the theorem Cayley- Hamilton theorem.
3. Explain Indefinite integrals and its properties.
4. Define the term augmented matrix.
5. Define the derivative at x=2 of a function f(x) = 3x.
6. Define Roller's theorem.
7. Discuss vector and types of vectors.
8. Solve A= (1, 0, 2) and B= (7,2,1) then find vector AB.
9. Solve $A^2$if A=$\begin{bmatrix} 2 & 1 & 1 \\ 4 & 3 & 2 \\ 1 & 2 & 2 \end{bmatrix}$
10. Show the magnitude of a vector with end points (5, 7) and (-2, 5).

( 8 x 3 = 24 Mark )

**SECTION B** (Short Essay) Answer all questions
Each question carries **6** Mark

Overall ceiling 36 Mark

11. Compute $f'(x)$ of $f(x)$=4$x$2+2$x$=3 using first principle method.
12. Find the determinant of the matrix A=$\begin{bmatrix} 1 & 3 & 0 \\ 2 & 6 & 4 \\ -1 & 0 & 2 \end{bmatrix}$

13. Find $\int tanx$ dx.

14. Solve the system of equation using Gauss Jordan method

$$2x-y+2z=8$$

$$3x+2y-2z=-1$$

$$5x+3y-3z=3$$

15. Compute $\int_1^2 \frac{x}{(x+1)\,(x+2)}\,dx$

16. Compute inverse of A=$\begin{bmatrix} 2 & 1 & 2 \\ 2 & 2 & 1 \\ 1 & 2 & 2 \end{bmatrix}$

17. Formulate $\frac{dy}{dx} if\ y=sin^2x\ cosx$.

18. Find the area of a parallelogram whose adjacent sides are given by the vectors

$\vec{a} = 3\hat{\imath} + \hat{\jmath} + 4\hat{k}, \vec{b} = \hat{\imath} - \hat{\jmath} + \hat{k}$

(6 x 6= 36 Mark)

**SECTION C** (Essay) Answer any One questions
Each question carries 10 Mark

19. Solve the following linear equations.

$$3x-y+14z=7$$

$$2x+2y-3z=0$$

$$X-12y-18\ z=3$$

20. Solve the Eigen value and Eigen vector of $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & 1 & 3 \end{bmatrix}$

(1 x 10= 10 Mark)

Name……...

Reg.No…….

# FIRST SEMESTER B.C.A DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION

# NOVEMBER 2024

**(SHFYUGP)**

BCA 1 CJ 101 – FUNDAMENTALS OF COMPUTERS AND COMPUTATIONAL THINKING

CREDITS : 4

(2024 admission onwards)

Time : Two Hours Maximum : 70 Marks

**SECTION A** (Short Answer) Answer **all** questions
Each question carries **3** Mark

Overall ceiling 24 Mark

1. Define Algorithm? How to write a good algorithm.
2. Compare the Difference between RAM and ROM
3. Compute the term Single core Processors
4. Discuss about OS classifications
5. Summarize POST
6. Explain the use of File systems.
7. Show that the components of computational thinking
8. Distinguish the difference of GPU and APU
9. Justify the term Active components
10. Construct the figure Transistor and its function

( 8 x 3 = 24 Mark )

**SECTION B** (Short ESSAY) Answer **all** questions
Each question carries **6** Mark

Overall ceiling 36 Mark

11. Define Network Interface and its characteristics
12. analyze the term Boot Manager and its types
13. Demonstrate with figure Von Neumann Model
14. Describe Storage devices and its features
15. Explain the characteristics of Intuition and Precision
16. Illustrate with example Decimal to Binary

17. Apply the difference between Application software and System software

18. Summarize the advantages of Motherboard

( 6 x 6= 36 Mark )

**SECTION C** (ESSAY) Answer any **One** questions
Each question carries **10** Mark

19. Discuss the term ALGORITHM and what are qualities of a good algorithm?

20. Summarize the concept of memory technologies and its architecture

( 1 x 10= 10 Mark )