# Maharaja Ranjit Singh Punjab Technical University
# Bathinda-151001

## FACULTY OF SCIENCES
**SYLLABUS**

**FOR**

## Bachelor in Computer Applications (Hons.) / BCA (Hons.)

(Undergraduate Certificate in Computer Applications, Undergraduate Diploma in Computer Applications, Bachelor in Computer Applications (BCA), Bachelor in Computer Applications (Honours) and Bachelor in Computer Applications (Honours with Research))

**2026 BATCH ONWARDS**
**(4 YEAR PROGRAMME)**

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## SCHEME FOR BACHELOR IN COMPUTER APPLICATIONS (HONS.) PROGRAMME

**Course Name: Bachelor in Computer Applications (BCA)**
Undergraduate / Three or Four Years/6 or 8 Semesters with multiple entry and exit. The following option will be made available to the students joining BCA Research Program:

a. **One year:** Undergraduate Certificate in Computer Applications
b. **Two years**: Undergraduate Diploma in Computer Applications
c. **Three years**: Bachelor in Computer Applications (BCA)
d. **Four years**: Bachelor in Computer Applications with Honours: BCA (Honours) or Bachelor in Computer Applications Honours with Research: BCA (Honours with Research)

**Minimum Eligibility Criteria:**
**Minimum eligibility criteria for opting the course in the fourth year will be as follows:**

1. **BCA (Honours with Research):** BCA Degree
2. **BCA (Honours)**: BCA Degree

Note: The students who are eligible for BCA (Honours with Research) shall have choice to pursue either BCA (Honours) or BCA (Honours with Research).

**SEMESTER-WISE CREDIT DISTRIBUTION:**
SEMESTER-WISE CREDIT DISTRIBUTION OF PROPOSED BCA [BCA (HONOURS) AND BCA (HONOURS WITH RESEARCH)] PROGRAMME:

| Semester | Core Courses | Ability Enhancement Courses | Multi-Disciplinary Elective Courses | Value-Added Courses | Skill-Enhancement Courses | Discipline Specific Elective | Total |
|---|---|---|---|---|---|---|---|
| I | 8 | 2 | 2 | 2 | 7 | - | 21 |
| II | 12 | - | - | 3 | 9 | - | 24 |
| III | 11 | - | - | 2 | 6 | 3 | 22 |
| IV | 15 | - | - | 1 | 4 | 3 | 23 |
| V | - | - | - | - | 8 | 15 | 23 |
| VI | 4 | 1 | - | 1 | 4 | 10 | 20 |
| | | **BCA (Honours)** | | | | | |
| VII | 5 | - | 3 | - | 4 | 8 | 20 |
| VIII | - | - | - | 1 | 7 | 12 | 20 |
| | | **BCA (Honours with Research)** | | | | | |
| VII | 12 | - | - | - | - | 8 | 20 |
| VIII | - | - | - | - | - | 20 | 20 |

**Category-wise distribution**

| Description | Core Courses | Ability Enhancement Courses | Multi-Disciplinary Elective Courses | Value-Added Courses | Skill Enhancement Courses | Discipline Specific Elective | Total |
|---|---|---|---|---|---|---|---|
| BCA | 50 | 3 | 2 | 9 | 38 | 31 | 133 |
| BCA (Honours) | 55 | 3 | 5 | 10 | 49 | 51 | 173 |
| BCA (Honours with Research) | 62 | 3 | 2 | 9 | 38 | 59 | 173 |
| **3 Years BCA Program** | | | | | | **Total Credits = 133** | |
| **4 Years BCA (Honours) and BCA (Honours with Research)** | | | | | | **Total Credits = 173** | |

**Note**: Students can take extra credit course from their own department or from other department as per the University norms.

| 1st Semester | | Course Type | Contact Hours. | | | Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| Sub. Code | Subject | | L | T | P | Int. | Ext. | Total | |
| BBCAS1-101 | Mathematical Foundations of Computer Science – I | CC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAC1-102 | Problem-Solving Techniques | SEC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAC1-103 | Problem-Solving Techniques Lab | SEC | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| BBCAS1-104 | Computer Architecture | CC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAS1-105 | Office Automation Lab | CC | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| BBCAA1-106 | General English – I | AEC | 1 | 1 | 0 | 40 | 60 | 100 | 2 |
| BBCAO1-107 | Indian Knowledge System^ | MDE | 2 | 0 | 0 | 20 | 30 | 50 | 2 |
| BBCAV1-108 | Environmental Science and sustainability | VAC | 2 | 0 | 0 | 20 | 30 | 50 | 2 |
| BBCAA1-109 | Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1-0) [optional course]** | AEC | 1 | 1 | 0 | – | – | – | 0 |
| BENPC1-101 | Entrepreneurship Setup and Launch (App Based) | SEC | - | - | - | 100 | - | 100 | 2 |
| BMNCC0-054 | Disaster Risk Reduction and Management: Skills for Safety and Resilience | SEC | 1 | 0 | 2 | 50 | 50 | 100 | 0 |
| BMNCC0-010 | Universal Human values - I | HSMC | 22 hrs (to be completed during 21 days SIP)* | | | Satisfactory/ Not-satisfactory | | | 0 |
| **Total** | | | **16** | **2** | **10** | **470** | **430** | **900** | **21** |

**Note:**

1. There will be Induction Programme of 3 weeks before start of normal classes.
2. Universal Human Values -I is non-credit Course; however, it is necessary to secure at least E grade in that course.

* As per AICTE SIP Manual Hour Plan available at https://fdp-si.aicte-india.org/

^Indian Knowledge System: Indian Culture and Civilization Indian Vision for Human Society Indian Science Indian Town Planning and Architecture Indian Mathematics and Astronomy Indian Aesthetics Indian Health, Wellness

**Indian Languages: Sanskrit/Hindi/All Regional languages

| Induction program(mandatory) | Three-week duration |
|---|---|
| Induction program for students to be offered right at the start of the first year. **Refer Appendix III** | • Physical activity<br>• Creative Arts<br>• Universal Human Values<br>• Literary<br>• Proficiency Modules<br>• Lectures by Eminent People<br>• Visits to local Areas<br>• Familiarization to Department/Branch & Innovation |

| 2nd Semester | | Course Type | Contact Hours. | | | Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| **Sub. Code** | **Subject** | | **L** | **T** | **P** | **Int.** | **Ext.** | **Total** | |
| BBCAS1-201 | Mathematical Foundations of Computer Science – II | CC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAS1-202 | Data Structures | CC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAS1-203 | Data Structures Lab | CC | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| BBCAS1-204 | Operating Systems | CC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAS1-205 | Operating Systems Lab | CC | 0 | 0 | 2 | 30 | 20 | 50 | 1 |
| BBCAC1-206 | Object Oriented Programming using Java | SEC | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BBCAC1-207 | Object Oriented Programming using Java Lab | SEC | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| BBCAC1-208 | Web Technologies | SEC | 1 | 0 | 0 | 20 | 30 | 50 | 1 |
| BBCAC1-209 | Web Technologies Lab | SEC | 0 | 0 | 2 | 30 | 20 | 50 | 1 |
| BBCAV1-210 | Indian Constitution | VAC | 2 | 0 | 0 | 20 | 30 | 50 | 2 |
| BBCAA1-211 | Additional Course - Indian or Foreign Language Other than Mother Tongue and English [optional course]* | AEC | 1 | 1 | 0 | – | – | – | 0 |
| BENPC1-201 | Entrepreneurship Marketing Basics | SEC | - | - | - | 100 | -- | 100 | 2 |
| BGEPV1-201 | General Proficiency | VAC | 1 | 0 | 0 | 100 | 0 | 100 | 1 |
| **Total** | | | **17** | **1** | **12** | **580** | **420** | **1000** | **24** |

*Indian Languages: Sanskrit/Hindi/All Regional languages

**After Year 1, Students are advised to take Social Responsibility and Community Engagement - encompassing Community Engagement with an NGO in the vacation time.**

An UNDER GRADUATE CERTIFICATE IN COMPUTER APPLICATIONS will be awarded, if a student wishes to exit at the end of first year.

**Exit Criteria after First Year of BCA Programme**

Students will have the option to exit the Bachelor of Computer Applications (BCA) program after successfully completing the first year. Upon exit, they will be awarded a "***UG Certificate in Computer Applications"***. To be eligible for this certificate, students must complete an additional 4 credits in one of the following areas:

1. **Skill-Based Subject**: A course designed to enhance practical and technical skills in the field of computer Applications.
2. **Work-Based Vocational Course**: A vocational course offered during the summer term that emphasizes hands-on training and workplace readiness.
3. **Internship/Apprenticeship**: A professional internship or apprenticeship program in a relevant field, with a minimum duration of 8 weeks, which will take place after the second semester.
4. **Social Responsibility and Community Engagement**: Active engagement with an NGO or community organization for a minimum duration of 8 weeks, focusing on real-world problem-solving, social responsibility, and community service.

   The mode and specifics of these additional credits will be determined by the University and students will be required to complete the 08-week program during the summer term following their second semester.
   The exiting students will clear the subject / submit the Internship Report as per the University schedule.

**Re-entry Criteria into Second Year (third semester)**

The student who takes an exit after one year with an award of certificate may be allowed to re-enter into third semester for completion of the BCA Program as per the University schedule after earning requisite credits in the first year.

# FIRST SEMESTER

## MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE - I

**Subject Code: BBCAS1-101** **L T P C** **Duration: 45 Hrs.**
**3 0 0 3**

**Course Objectives:**

**CO1:** Explain the fundamental concepts of sets, relations, and functions.

**CO2:** Apply counting principles and recurrence relations to solve discrete mathematical problems.

**CO3:** Analyse graphs and trees using their properties, representations, and traversal concepts.

**CO4:** Apply matrix algebra and matrix operations to solve mathematical problems.

### UNIT - I (15 Hrs.)

**Sets, Relations and Functions:**
Set, Set Operations, Properties of Set Operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Types of Relations, Equivalence Relation, Equivalence relation and partition on a set. Functions, properties of functions (domain, range), composition of functions, subjective (onto), injective (one-to-one) and bijective functions, inverse of functions.

### UNIT - II (10 Hrs.)

**Counting and Recurrence Relation:**
Basics of counting, permutation, combination. Recurrence relations. Solving linear recurrence relation with constant coefficients using characteristic equation roots method.

### UNIT - III (10 Hrs.)

**Elementary Graph Theory:**
Basic terminologies of graphs, connected and disconnected graphs, subgraph, paths and cycles, complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs. Trees, properties of trees, concept of spanning tree. Planar graphs.

### UNIT - IV (10 Hrs.)

**Matrix Algebra:**
Types of matrices, algebra of matrices–addition, subtraction, and multiplication of matrices, determinant of a matrix, symmetric and skew-symmetric matrices, orthogonal matrix, rank of a matrix, inverse of a matrix.

**Text Books:**

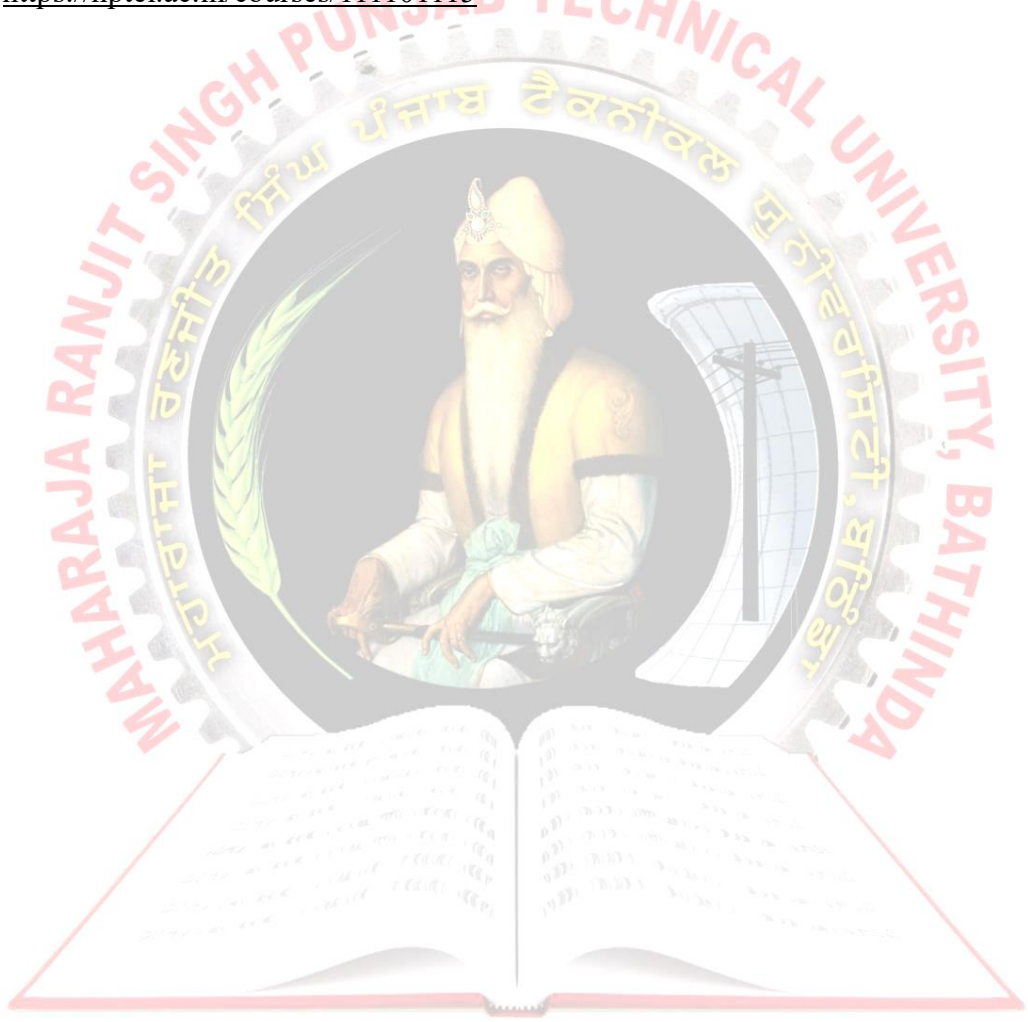
1. Reena Garg (2024), "Engineering Mathematics", Khanna Book Publishing Company.
2. Reena Garg (2023), "Advanced Engineering Mathematics", Khanna Book Publishing Company.
3. Bernard Kolman, Robert Busby, and Sharon Ross (2015), "Discrete Mathematical Structures", 6th Edition, Pearson Education.
4. Narsingh Deo (1979), "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall India.
5. A. R. Vasishtha and A. K. Vasishtha (2022), "Matrices", Krishna Prakashan.

**Reference Books:**

1. Ralph P. Grimaldi and B. V. Ramana (2007), "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education.
2. Kenneth H. Rosen and Kamala Krithivasan (2019), "Discrete Mathematics and its Applications", McGraw Hill, India.
3. Douglas B. West (2015), "Introduction to Graph Theory", 2nd Edition, Pearson Education.

**Web Resources:**

1. https://nptel.ac.in/courses/106103205
2. https://nptel.ac.in/courses/111101115



## PROBLEM-SOLVING TECHNIQUES

**Subject Code: BBCAC1-102** **L T P C** **Duration: 45 Hrs.**
**3 0 0 3**

**Course Objective:**

**CO1:** Explain problem-solving concepts, computational problems, algorithms, and programming languages.

**CO2:** Develop algorithms and pseudocode using structured programming constructs.

**CO3:** Implement algorithms using C programming constructs, arrays, strings, and functions.

**CO4:** Apply debugging and file-handling techniques to test and analyse C programs.

### UNIT - I (10 Hrs.)

Problems And Problem Instances, Generalization and Special Cases, Types of Computational Problems, Classification of Problems, Analysis of Problems, Solution Approaches, Algorithm Development, Analysis of Algorithm, Problem-Solving Steps (Understand the Problem, Plan, Execute, And Review), Breaking the Problem into Sub problems, Input/Output Specification, Input Validation, Pre and Post Conditions.

### UNIT - II (15 Hrs.)

**Structured Programming Concepts:** Sequence (Input/Output/Assignment), Selection (If, If-Else) And Repetition (For, While, Do-While) Statements, Control Structure Stacking and Nesting, Different Kinds of Repetitions: Entry Controlled, Exit Controlled, Counter Controlled, Definite, Indefinite and Sentinel-Controlled Repetitions.

### UNIT - III (10 Hrs.)

C Language: Introduction To Programming Languages, Different Generations of Programming Languages. Typed Vs Typeless Programming Languages, History of C Language, C Language Counterparts For Input (scanf()), Output (printf()) Statements, Assignment, Arithmetic, Relational and Logical Operators, Operator Precedence and Associatively. If, If-Else Statements, For, While, Do-While Statements. Data Types. Simple Problems Involving Input, Output, Assignment Statement, Selection and Repetition.

### UNIT - IV (10 Hrs.)

Modular Programming, Top-Down and Bottom-Up Approaches to Problem-Solving, Recursion, Problems on Arrays: Reading and Writing of Array Elements, Maximum, Minimum, Sum, Average, Median and Mode.

C Language: Function Definition and Declaration (Prototype), Role of Return Statement, One Dimensional and Two-Dimensional Arrays. String Functions. Other Operators, Debugging.

**Text Books:**

1. Nagaraju Y. Venkatesh (2024), "Practical C Programming for Problem-Solving", Khanna Book Publishing Company.
2. AICTE (2024), "Programming for Problem-Solving (with Lab Manual)", Khanna Book Publishing Company.
3. Harvey Deitel and Paul Deitel (2015), "C How to Program", 9th Edition, Pearson India.
4. R. G. Dromey, "How to Solve It by Computer".

**Reference Books:**

1. Brian W. Kernighan and Dennis Ritchie (2015), "The C Programming Language", 2nd Edition, Pearson.
2. Jeri Hanly and Elliot Koffman (2015), "Problem-Solving and Program Design in C", 8th Edition, Pearson.

## PROBLEM-SOLVING TECHNIQUES LAB

**Subject Code: BBCAC1-103** **L T P C**
**0 0 4 2**

1. Converting degrees Celsius to Fahrenheit and vice versa?
2. Display three input numbers in sorted (non-decreasing) order?
3. Given a positive integer value n (>= 0) display number, square and cube of numbers from 1 to n in a tabular format?
4. Given an input positive integer number, display odd numbers from in the range [1,n]?
5. Display first mathematical tables, each table up to 10 rows? Generalise this to display first n (> 0) mathematical tables up to m (m > 0) rows?
6. Display following patterns of n rows (n > 0), For the below examples n = 5? For each pattern write a separate algorithm/program?

| | | | |
|---|---|---|---|
| $<br>$$<br>$$$<br>$$$$<br>$$$$$ | $<br>$$<br>$$$<br>$$$$<br>$$$$$ | 12345<br>1234<br>123<br>12<br>1 | 12345<br>1234<br>123<br>12<br>1 |

7. Display the following patterns of n rows (n > 0), for the below examples n = 5?

| Hollow square pattern: | Triangle Patterns with numbers: | Square with diagonals: | Diamond Pattern |
|---|---|---|---|
| #####<br>#  #<br>#  #<br>#  #<br>##### | 1<br>121<br>12321<br>1234321<br>123454321 | * * * * *<br>* *  * *<br>* * *<br>* *  * *<br>* * * * * | *<br>***<br>*****<br>***<br>* |

8. Given the first term (a), difference/multiplier (d) and number of terms (n > 0), display the first n terms of the arithmetic/geometric progression?
9. Display the first n (n > 0) terms of the Tribonacci sequence?
10. Given two positive integer numbers n1 and n2 check if the numbers are consecutive numbers of the fibonacci sequence?
11. Compute the sum of a sequence of numbers entered using sentinel controlled repetition?
12. Check if a given positive integer number is a prime number or not?
13. Compute prime factors of a positive integer number?
14. Check if two positive integer numbers are amicable numbers or not?
15. Check if a given positive integer number is a perfect number or not?
16. Check if a given positive integer number Armstrong number or not?

17. Write a program to display a number in text form. For example If the number is 5432 the output should be “FIVE FOUR THREE TWO”?
*
18. Compute body mass index, BMI = weight in KGs / (HeightinMeters*HeightinMeters), Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges:
BMI Values
Underweight: less than 18.5
Normal: >=18.5 and <25
Overweight: >=25 and < 30
Obese: >= 30
19. Write a recursive program to count the number of digits of a positive integer number?
20. Recursive solutions for the following problems:
    a. Factorial of a number?
    b. Display digits of a number from left to right (and right to left)?

## COMPUTER ARCHITECTURE

**Subject Code: BBCAS1-104** **L T P C** **Duration: 45 Hrs.**
**3 0 0 3**

Course Objectives:

CO1: Explain digital principles, Boolean algebra, logic gates, K-maps, and number systems.

CO2: Explain and analyse combinational and sequential circuits.

CO3: Explain the organization and operation of basic computers and CPU components.

CO4: Analyse pipelining, I/O organization, memory hierarchy, and memory management techniques.

### UNIT -I (10 Hrs.)

**Digital Principles:** Definition for Digital signals, Digital logic, Digital computers, Von Neumann Architecture, Boolean Laws and Theorems, K-Map: Truth Tables to K-Map, 2, 3 and 4-variable K Map, K-Map Simplifications, Don't Care Conditions, SOP and POS. **Number Systems:** Decimal, Binary, Octal, Hexadecimal, Number System Conversions, Binary Arithmetic, Addition and subtraction of BCD, Octal Arithmetic, Hexadecimal Arithmetic, Binary Codes, Decimal Codes, ASCII, EBCDIC, Excess3 Code, The Gray Code.

### UNIT- II (10 Hrs.)

**Combinational Circuits:** Half Adder and Full Adder, Subtractor, Decoders, Encoder, Multiplexer, Demultiplexer

**Sequential Circuits:** Flip-Flops- SR Flip- Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop, 4-bit register with parallel load, Shift Registers- Bidirectional shift register with parallel load Binary Counters-4-bit synchronous and Asynchronous binary counter.

### UNIT- III (15 Hrs.)

**Basic Computer Organization and Design:** Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator logic.

**Central Processing Unit:** Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC), RISC Vs CISC.

### UNIT- IV (10 Hrs.)

**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline. Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input-Output Processor (IOP), Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

**Text Books:**

1. Donald P. Leach, Albert Paul Malvino, Goutam Saha (2011), "Digital Principles & Applications", Tata McGraw Hill Education Private Limited.
2. M. Morris Mano, "Computer System Architecture". 3rd Edition, Pearson/PHI.

**Reference Books:**

1. William Stallings, "Computer Organization and Architecture", 6th Edition, Pearson/PHI.
2. Andrew S. Tanenbaum, "Structured Computer Organization", 4th Edition, PHI/Pearson.
3. M. V. Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.
4. Ikvinderpal Singh, "Computer Organization Architecture", Khanna Book Publishing.

## OFFICE AUTOMATION LAB

**Subject Code: BBCAS1-105** **L T P C**
**0 0 4 2**

**Course Objectives:**

**CO1:** Understand the basic features of word processing, spreadsheet, and presentation software.
**CO2:** Apply office applications to create and manage documents, spreadsheets, and presentations.
**CO3:** Perform basic documentation, data processing, calculations, and data analysis using office applications.
**CO4:** Create and deliver effective interactive multimedia presentations.

## List of Experiments: -

1. Creating and formatting a professional resume.
2. Preparing an assignment using tables, footnotes, hyperlinks, and formatting tools.
3. Designing a newsletter using columns, images, shapes, and text formatting.
4. Creating a feedback form using forms and Mail Merge.
5. Creating and formatting a business letter using templates and styles.
6. Creating a scheduler using spreadsheet software.
7. Performing calculations using formulas and functions.
8. Preparing a performance analysis sheet using charts and conditional formatting.
9. Preparing a cricket/badminton scorecard using formulas and functions.
10. Creating a student marksheet using formulas, functions, and data validation.
11. Creating and formatting charts for data analysis.
12. Sorting, filtering, and summarizing data using spreadsheet tools.
13. Creating an interactive multimedia presentation.
14. Creating a presentation using images, audio, video, hyperlinks, and animations.
15. Creating a presentation using tables, charts, SmartArt, and transitions.
16. Creating and managing an email account and composing professional emails.
17. Using search engines effectively to find, evaluate, and organize information.
18. Creating and managing files and folders using basic file-management techniques.
19. Performing online banking and digital payment transactions in a simulated environment.
20. Creating an integrated office project combining a document, spreadsheet, and multimedia presentation.

## GENERAL ENGLISH – I

**Subject Code: BBCAA1-106** **L T P C** **Duration: 30 Hrs.**
**1 1 0 2**

**Course Objectives:**

1. To provide learning environment to practice listening, speaking, reading and writing skills.
2. To assist the students to carry on the tasks and activities through guided instructions and materials.
3. To effectively integrate English language learning with employability skills and training.
4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

### UNIT - I (8 Hrs.)

**Vocabulary Building**
The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

**Basic Writing Skills**
Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

### UNIT - II (7 Hrs.)

**Identifying Common Errors in Writing**
Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies

### UNIT - III (7 Hrs.)

**Nature and Style of Sensible Writing**
Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Writing Practices, Comprehension, Précis Writing, Essay Writing

### UNIT - IV (8 Hrs.)

**Oral Communication (This Module involves interactive practice sessions in Language Lab)**
Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

**Text/Reference Books:**

1. Anjana Tiwari (2023), "Communication Skills in English (with Lab Manual)", Khanna Book Publishing Co.
2. KulBhushan Kumar (2022), "Effective Communication Skills", Khanna Book Publishing.
3. Michael Swan (1995), "Practical English Usage", Oxford University Press.
4. F. T. Wood (2007), "Remedial English Grammar", Macmillan.
5. William Zinsser (2001), "On Writing Well", Harper Resource Book.
6. Liz Hamp-Lyons, Ben Heasly (2006), "Study Writing", Cambridge University Press.
7. Sanjay Kumar, PushpLata (2011), "Communication Skills", Oxford University Press.
8. CIEFL, Hyderabad, "Exercises in Spoken English, Parts I-III", Oxford University Press.

## INDIAN KNOWLEDGE SYSTEM

**Subject Code: BBCAO1-107** **L T P C** **Duration: 30 Hrs.**
**2 0 0 2**

**Course Objectives**

The main aim of this course is:

**CO1.** To Creating awareness amongst the youths about the true history and rich culture of the country**.**
**CO2.** To Understanding the scientific value of the traditional knowledge of India
**CO3.** To Promote the youths to do research in the various fields of IKS.
**CO4.** Adding career, professional and business opportunities to the youths

### UNIT - I (7 Hrs.)

**Indian Civilization**: Genesis of the land, Antiquity of civilization, On the Trail of the Lost River, Discovery of the Saraswatī River, Sindhu Civilization.

**IKS in ancient India and in modern India:** Traditional Knowledge System, The Vedas,Main Schools of Philosophy, Ancient Education System, the Takṣasila University, the Nalanda University, Alumni, Knowledge Export from Bharata.

### UNIT - II (4 Hrs.)

**Development of scientific thoughts in ancient India**: Development of Science and Technology in ancient India, Astronomy - Aryabhatta and Varahmihir, Mathematics- Shulvasutra and Baksali manuscript, Formulation of Arithmetic, Algebra and trigonometry

### UNIT - III (9 Hrs.)

**Development of Engineering Science & Technology in India**: Agriculture, Metallurgy, Various Industries- Silk Industry, cotton Industry and ship building, Indian Fine Arts Cave architecture, Temple architecture Vastu- Vidya Sculpture Forts and Stepwells Observatories Paintings **Development of Performing arts & culture in India**- Music, Art of singing, Art of dancing, Natyakala, Cultural traditions, Folk arts

### UNIT - IV (7 Hrs.)

**Life, Environment, and Health:** Ethnic Studies, Life Science in Plants, Anatomy, Physiology, Agriculture, Ecology and Environment, Āyurveda, Integrated Approach to Healthcare, Medicine, Microbiology, Medicine, Surgery, and Yoga, etc.

***Note:*** Relevant case studies, historical examples, and contemporary applications of Indian Knowledge Systems shall be discussed in class to promote critical thinking, analytical skills, and the practical application of traditional knowledge in modern contexts.

**Student Project (Compulsory):** Students shall undertake an individual or group project on a topic related to Indian Knowledge Systems, such as Indian civilization, Vedic knowledge, ancient universities, Indian philosophy, science and technology, mathematics, astronomy, architecture, fine arts, Ayurveda, Yoga, agriculture, ecology, or environmental sustainability. The project should apply course concepts to analyze historical contributions and contemporary relevance. Students shall submit a project report and deliver a presentation based on their

findings. The project will form part of the internal assessment and shall be considered equivalent to one assignment.

**Recommended Books:**

1. Levin &Rubin,‘ Statistics for Management’, Prentice Hall
2. Pillai& Bagavathi. Statistics, Theory and Practice’, SC hand Publishing
3. Crouched,‘Statistics: Making Business Decisions’,Tata Mc Graw Hill
4. Gupta&Gupta,‘An Introduction to Statistical Methods’,Vikas Publications
5. SP Gupta,‘Statistical Methods’,Sultan Chand
6. Sharma J.K.‘Business Statistics’,Vikas Publishing House
7. C.R.Reddy,‘Quantitative Techniques for Management Decisions’, Himalaya Publishing

## ENVIRONMENTAL SCIENCE AND SUSTAINABILITY

**Subject Code: BBCAV1-108** **L T P C** **Duration: 30 Hrs.**
**2 0 0 2**

**Course Outcomes:**

**CO1:** Explore the basic environmental concepts and issues relevant to the business and management field.

**CO2:** Recognize the interdependence between environmental processes and socio-economic dynamics.

**CO3:** Determine the role of business decisions, policies, and actions in minimizing environmental degradation.

**CO4:** Identify possible solutions to curb environmental problems caused by managerial actions.

**CO5:** Develop skills to address immediate environmental concerns through changes in business operations, policies, and decisions.

### UNIT - I (8 Hrs.)

**Understanding Environment, Natural Resources, and Sustainability**

Fundamental environmental concepts and their relevance to business operations; Components and segments of the environment, the man-environment relationship, and historical environmental movements. Concept of sustainability; Classification of natural resources, issues related to their overutilization, and strategies for their conservation. Sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education.

### UNIT - II (8 Hrs.)

**Ecosystems, Biodiversity, and Sustainable Practices**

Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation.

### UNIT - III (7 Hrs.)

**Environmental Pollution, Waste Management, and Sustainable Development**

Various types of environmental pollution, including air, water, noise, soil, and marine pollution, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts.

### UNIT - IV (7 Hrs.)

**Social Issues, Legislation, and Practical Applications**

Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics. Role of businesses in achieving sustainable development goals and promoting responsible consumption. Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention

and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Environmental justice, environmental refugees, and the resettlement and rehabilitation of affected populations; Ecological economics, human population growth, and demographic changes in India.

**Text Books:**

1. M. P. Poonia, "Environmental Studies", 3rd Edition, Khanna Book Publishing Co.
2. E. Bharucha, "Textbook of Environmental Studies", Orient Blackswan Private Ltd.
3. D. Dave, S. S. Katewa, "Textbook of Environmental Studies", Cengage Learning India Pvt Ltd.
4. R. Rajagopalan, "Environmental Studies", 4thEdition, From Crisis to Cure, Oxford University Press.
5. G. T. Miller, S. Spoolman, "Living in the Environment" 20thEdition, Cengage.
6. M. Basu, S. J. Xavier Savarimuthu, "Fundamentals of Environmental Studies", Cambridge University Press.
7. M. G. Roy, "Sustainable Development: Environment, Energy and Water Resources", Ane Books.
8. K. Pritwani, "Sustainability of Business in the Context of Environmental Management", CRC Press.
9. R. T. Wright, D. F. Boorse, "Environmental Science: Toward a Sustainable Future", 13thEdition, Pearson.

**Web links:**

- https://www.ourplanet.com
- https://www.undp.org/content/undp/en/home/sustainable-development-goals.html
- www.myfootprint.org
- https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem /ecosystem.html

## DISASTER RISK REDUCTION AND MANAGEMENT: SKILLS FOR SAFETY AND RESILIENCE

**Subject Code: BMNCC0-054** **L T P C** **Duration: 45 Hrs.**
**1 0 2 0**

**Course Objective:** To equip students with the knowledge, skills and competencies to identify, assess, mitigate disasters and design effective disaster management plans and strategies at individual, institutional and community levels, aligning with national and global frameworks.

**Course Outcomes:**

CO1: Identify hazards, vulnerabilities and risks at individual, institutional and community levels.
CO2: Outline the legal and institutional frameworks of DRR in India and globally.
CO3: Demonstrate life-saving skills, emergency communication, disaster response and risk mitigation techniques.
CO4: Utilize and implement basic tools and technologies for risk assessment, preparedness and resilience-building.
CO5: Prepare disaster management plans and design community awareness activities, or prototypes in regional/local contexts.

**UNIT I Understanding Disaster Risk Reduction and Management (12 Hrs.)**

- Basic concepts and terminology: Hazard, Vulnerability, Capacity, Exposure, Disaster, Risk, Disaster Management & Disaster Risk Reduction.
- Hazard profile of India: Regional profile.
- Disaster Management Cycle: Mitigation, preparedness, response, relief, recovery, rehabilitation.
- Policy and legal frameworks: DM Act 2005, DM Amendment Act 2025, National Policy, State-specific Acts; PM 10 Points agenda.
- International frameworks: Sendai Framework, Paris Agreement, SDGs.
- Role of Institutions in DRR (overview only): NDMA, NIDM, IMD, CWC, GSI, BIS, ISRO, INCOIS, SDMA, DDMA, NDRF.

1. Case studies of different disasters in India: Lessons learned (minimum 2).

**UNIT II Preparedness, Mitigation and Response Planning (11 Hrs.)**

a. Framework for Developing Disaster Management Plans.
b. Hazard, Vulnerability, Capacity and Risk (HVCR) Assessment tools and techniques: Transect Walk, Hazard mapping, Problem tree, Chapatti diagram etc.
c. Mitigation and Preparedness: Evacuation planning, mock drills, tabletop exercises; disaster specific mitigation, Crowd Management techniques.
d. Basics of Incident Response System (IRS).
e. Role of emergency forces: NDRF, SDRF, police, fire services, armed forces, NCC, NSS.
f. Planning for more vulnerable groups.
g. Emerging technologies: Drones, digital literacy, mobile apps (GIRI tool, SAFAR, Meghdoot, UMANG, Sachet, CWC Flood Alerts, IMD, BIS, IHIP), social media for DRR.
h. Basics of safe construction and structural & nonstructural audit exercise (safety of home/ college buildings).
i. Funding mechanisms for disasters in India.
j. Emergency Communication Network.

**UNIT III Life-Saving Skills (12 Hrs.)**

a. First Aid in disasters: Golden hour concept, CPR, wounds, choking, burns, fractures, animal bites (snake/dog/rabid), heat-related illnesses, triaging, stampede.
b. Household and personal preparedness and protection: 72-hour emergency kit, safe food storage, water purification, ORS use, water sanitation and hygiene (WASH) and Infection Prevention Control (IPC) practices, Basic Sign Language.
c. Search and Rescue methods.
d. Fire safety and electrical/gas/LPG safety: Causes, prevention, fire extinguisher demonstration, indigenous methods (Natural first-aid remedies- aloe vera, turmeric, coconut oil, salt solution); traditional risk-reduction practices.
e. Disaster-specific response: Floods, landslides, earthquakes, CBRN emergencies, pandemics, drowning, lightning, gas leakage, cyclone, heatwave,coldwave.
f. Psychosocial support in DRR; Steps for implementing psychological first aid and its Importance • Public health preparedness: Public health impacts of various disasters, Prevention of post-disaster water-borne and vector-borne diseases.

**UNIT IV Field Exposure and Community Engagement (10 Hrs.)**

a. Field visits: District Emergency Operations Centre, State Disaster Response Force/ National Disaster Response Force units, fire stations, State Emergency Operations Center, hazardprone communities, heat-prone areas (flood-prone village, fire-vulnerable urban slum).
b. Practical exposure: Mock drills, demonstrations and simulations (multi-hazard, evacuation, earthquake, flood); interaction with responders and officials (Aapda Mitras, National Cadet Corps/National Service Scheme/Nehru Yuva Kendra Sangathan, Red Cross).
c. Community Engagement projects: Street plays (nukkad natak), awareness campaigns, DRR clubs (institute and community level clubs), Information, Education and Communication material (podcasts, videos, comics, photo essays, posters, Knowledge exchange webinars).
d. Environmental hazards: Youth/community participation (tree plantation, soil conservation).
e. Project/assignment: Preparation of institutional/household DM plan in local language; budget-friendly multi-disaster survival kit prototype; reflective field report, youth-led community engagement projects and creation of IEC/digital communication materials.
f. Multidisciplinary integration: Links with local governments, HEIs, youth/adolescent networks.
g. Activities for mitigating disaster risks: Increasing green cover, plantation and knowledge of human anatomy.
h. Interaction with: State, district, gram panchayat level officials, DRR helpline numbers, and knowledge of physical resources required and available locally; interview /session with disaster survivors.

**Books/Handbooks**

1. Sphere Handbook for humanitarian response standards.
   Link: https://spherestandards.org/handbook/
2. Health emergency and disaster risk management framework (Health EDRM),
   WHO. Link: https://www.who.int/publications/i/item/9789241516181

**Websites of Key Agencies**

1. National Disaster Management Authority (NDMA): https://ndma.gov.in
*India's apex body for policy and planning in disaster management.*
2. National Institute of Disaster Management (NIDM): https://nidm.gov.in
*Apex national level training and capacity-building institution for disaster risk reduction.*
3. India Meteorological Department (IMD): https://mausam.imd.gov.in
*Provides official weather forecasts, warnings and alerts.*
4. Central Water Commission (CWC): http://www.cwc.gov.in
*Responsible for flood forecasting and hydrological data.*
5. Flood Forecasting Portal (FFWC): https://ffs.india-water.gov.in/
*Real-time flood forecasting and inundation alerts for India.*
6. Geological Survey of India (GSI): https://www.gsi.gov.in
*Provides hazard maps and geological risk assessments.*
7. India Disaster Resource Network (IDRN): https://idrn.gov.in
*Inventory of emergency response resources across India.*
8. Coalition for Disaster Resilient Infrastructure (CDRI): https://cdri.world/
*Global initiative led by India for promoting resilient infrastructure.*
9. Indian Space Research Organisation (ISRO): https://www.isro.gov.in/
*Space agency of India; information regarding academic programmes and fellowships*
10. Indian Institute of Remote Sensing: https://www.iirs.gov.in/
*Research, educational programmes and resources related to remote sensing and geo-informatics*
11. DRDO Avalanche Warning Bulletin: https://drdo.gov.in/drdo/avalanche-warning-bulletin
*Snow and avalanche forecasts for high-altitude regions.*
12. Building Materials and Technology Promotion Council (BMTPC): https://www.bmtpc.org/
*Promoting sustainable, cost-effective, and disaster-resistant building materials and technologies*
13. National Information Centre of Earthquake Engineering (NICEE) at IIT Kanpur:
https://www.nicee.org/EQTips.php
*Learning Seismic Design and Construction*

**Mobile Applications**

1. Bhooskhalan App (GSI)
   *Reports and monitors landslide events in India.*
2. MausamGram App (IMD)
   *Hyperlocal weather forecast and alerts powered by IMD.*
3. Sachet App (NDMA)
   *Alerts for natural and human-induced disasters and industrial safety incidents.*
4. SAFAR (System of Air Quality and Weather Forecasting and Research):
   https://safar.tropmet.res.in/
*Real-time air quality and environmental health forecasting.*

1. **Evaluation Criterion:**
   a. **Internal Evaluation:**

| Sr. No. | Evaluation Criteria | Marks |
|---|---|---|
| a. | Mid Semester Test | 10 |
| b. | Quizzes/Assignments | 10 |
| c. | Field Work Report/Community Activity | 20 |
| d. | Presentation & Viva-Voce | 10 |
| | **Total:** | **50** |

**External Evaluation:** The external evaluation shall be conducted in accordance with the prevailing University examination pattern for theory courses and shall carry a ***maximum of 50 marks***. The paper shall be divided into three sections such that Section A shall be compulsory and shall consist of 10 questions each carrying 2 marks, while Section B shall consist of 5 questions each carrying 5 marks out of which students shall be required to attempt any 4, and Section C shall consist of 2 questions each carrying 10 marks out of which students shall be required to attempt one.

# SECOND SEMESTER

## MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE - II

**Subject Code: BBCAS1-201** **L T P C** **Duration: 45 Hrs.**
**3 0 0 3**

**Course Objective:**

**CO1:** Explain propositions, logical operations, quantifiers, logical equivalence, and methods of proof.

**CO2:** Explain fundamental algebraic structures, including semigroups, monoids, groups, and subgroups.

**CO3:** Apply numerical methods to solve equations, perform interpolation, and evaluate numerical integration problems.

**CO4:** Apply linear programming and transportation techniques to solve optimization problems.

### UNIT - I (12 Hrs.)

**Logic and Methods of Proof:**
Propositions, logical operations (basic connectives), compound statements, construction of truth tables, quantifiers, conditional statements, tautology, contradiction, contingency, logical equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF).

### UNIT - II (8 Hrs.)

**Algebraic Structures:**
Semigroup, Monoid, Group, Subgroup.

### UNIT - III (15 Hrs.)

**Numerical Methods:**
Concept and importance of errors in numerical methods, Solution of algebraic and transcendental equations: Bisection method and Newton-Raphson methods, Numerical Interpolation: Newton's Forward and Newton's Backward interpolation formula and Lagrange's formula, Numerical Integration: Trapezoidal rule and Simpson's 1/3 rule.

### UNIT - IV (10 Hrs.)

**Optimization Techniques:**
Linear programming: Introduction, LP formulation, Graphical method for solving LPs with two variables, Simplex method, Transportation problem: Definition, Linear form, Northwest Corner method, least cost method.

**Text Books:**

1. Bernard Kolman, Robert Busby, Sheldon Ross (2015), "Discrete Mathematical Structures", 6th Edition, Pearson Education.
2. S. S. Sastry (2022), "Introductory Methods of Numerical Analysis", 5thEdition, PHL.
3. Hamdy A. Taha (2003), "Operations Research: An Introduction", 8th Edition, Pearson Prentice Hall.
4. S. B. Singh (2023), "Discrete Structures", Khanna Book Publishing.

**Reference Books:**

1. Kenneth H. Rosen, Kamala Krithivasan (2019), "Discrete Mathematics and its Applications", McGraw Hill India.
2. J. G. Chakravorty, P. R. Ghosh (2017), "Linear Programming and Game Theory", Moulik Library.

3. J. K. Sharma (2007), "Operations Research: Theory and Applications", 4th Edition, Macmillan Publishers.

**Web Resources:**

1. https://nptel.ac.in/courses/111107127
2. https://www.math.iitb.ac.in/~siva/si50716/SI507lecturenotes.pdf

## DATA STRUCTURES

**Subject Code: BBCAS1-202** **L T P C** **Duration: 45 Hrs.**
**3 0 0 3**

**Course Objectives:**

**CO1:** Explain fundamental data structures, their representations, operations, and applications.

**CO2:** Analyse the time and space complexity of basic data-structure operations and algorithms.

**CO3:** Implement linear data structures, including arrays, linked lists, stacks, queues, and hashing techniques using C.

**CO4:** Implement and apply trees and graphs, including traversal and binary search tree operations, to solve computational problems.

### UNIT - I (10 Hrs.)

**Introduction and Overview:** Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Trade off.
**Arrays:** Definition and Classification of Arrays, Representation of Linear Arrays in Memory, Operations on Linear Arrays: Traversing, Inserting, Deleting, Searching, Sorting and Merging, Searching: Linear Search and Binary Search, Comparison of Methods. Sorting: Bubble Sort, Selection Sort, and Insertion Sort. Two-Dimensional Arrays, Representation of Two-Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multidimensional Arrays.

### UNIT - II (8 Hrs.)

**Linked Lists:** Definition, Comparison with Arrays, Representation, Types of Linked Lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. Applications of Linked Lists: Addition of Polynomials.
**Hashing and Collision:** Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.

### UNIT - III (15 Hrs.)

**Stacks:** Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List, Applications of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression.
**Queues:** Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List, Applications of Queues.

### UNIT - IV (12 Hrs.)

**Graphs:** Definition, Terminology, Representation, Traversal.
**Trees:** Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Search Trees, Inserting, Deleting and Searching in Binary Search Trees, Height Balanced Trees: AVL Trees, Insertion and Deletion in AVL Tree.

**Text Books:**

1. R. B. Patel (2023), "Expert Data Structures with C", Khanna Book Publishing Company.

2. Seymour Lipschutz (2011), "Data Structures with C", Schaum's Outlines, Tata McGraw-Hill.
3. YashavantKanetkar (2022), "Data Structures Through C", 4th Edition, BPB Publications.

**Reference Books:**

1. ReemaThareja (2014), "Data Structures Using C", 2nd Edition, Oxford University Press.
2. Ellis Horowitz, SartajSahni, Susan Anderson-Freed (2007), "Fundamentals of Data Structures in C", 2nd Edition, Universities Press.

**Web Resources:**

1. **GeeksforGeeks** - Data Structures Tutorial
2. **Khan Academy** - Algorithms Course

## DATA STRUCTURES LAB

**Subject Code: BBCAS1-203** **L T P C**
**0 0 4 2**

### Course Objectives:

**CO1:** Implement fundamental data structures.
**CO2:** Apply searching and sorting techniques to solve computational problems.
**CO3:** Implement stacks, queues, linked lists, and related operations.
**CO4:** Implement recursive algorithms and binary search trees.

**List of Experiments:**

1. Write a program for insertion and deletion operations in an array.
2. Write a program to search for an element in an array using Linear Search and Binary Search.
3. Write a program to sort an array using Bubble Sort, Selection Sort and Insertion Sort.
4. Write a program to merge two arrays.
5. Write a program to add and subtract two matrices.
6. Write a program to multiply two matrices.
7. Write a program to insert an element into a Singly Linked List:
   (a) At the beginning
   (b) At the end
   (c) At a specified position
8. Write a program to delete an element from a Singly Linked List:
   (a) At the beginning
   (b) At the end
   (c) A specified element
9. Write a program to perform the following operations in a Doubly Linked List:
   (a) Create
   (b) Search for an element
10. Write a program to perform the following operations in a Circular Linked List:
    (a) Create
    (b) Delete an element from the end
11. Write a program to implement stack operations using an array.
12. Write a program to implement stack operations using a linked list.
13. Write a program to add two polynomials using a linked lists.
14. Write a program to evaluate a postfix expression using a stack.
15. Write a program to perform the following using recursion:
    (a) Find the factorial of a number
    (b) Find the GCD of two numbers
    (c) Solve Towers of Hanoi problem
16. Write a program to implement simple queue operations using an array.
17. Write a program to implement circular queue operations using an array.
18. Write a program to implement circular queue operations using a linked list.
19. Write a program to perform the following operations on a binary search tree.
    (a) Preorder Traversal
    (b) Inorder Traversal
    (c) Postorder Traversal
20. Write a program to perform insertion operation in a binary search tree.

## OPERATING SYSTEMS

**Subject Code: BBCAS1-204** **L T P C** **Duration: 45 Hrs.**
**3 0 0 3**

**Course Outcomes:**
**CO1:** Explain the fundamentals of the operating system.
**CO2:** Comprehend multithreaded programming, CPU scheduling, process management, process synchronization, memory, deadlocks, and storage management.
**CO3:** Compare the performance of CPU scheduling algorithms
**CO4:** Identify the features of I/O and File Handling methods.

### UNIT - I (12 Hrs.)

**Operating Systems Overview:** Definition, Evaluation of O.S, Components & Services of OS, Structure, Architecture, types of Operating Systems, Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems.
**Operating Systems Structures:** Operating system services and systems calls, system programs, operating system structure, operating systems generations.

### UNIT - II (12 Hrs.)

**Process Management:** Process Definition, Process states, Process State transitions, Process Scheduling, Process Control Block, Threads, Concept of multithreads, Benefits of threads, Types of threads.
**Process Scheduling:** Definition, Scheduling objectives, Scheduling algorithms, CPU scheduling Preemptive and Non-preemptive Scheduling algorithms (FCFS, SJF and RR), Performance evaluation of the scheduling Algorithms

### UNIT - III (10 Hrs.)

**Process Synchronization:** Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors.
**Deadlocks:** System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.

### UNIT - IV (11 Hrs.)

**Memory Management:** Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, Segmentation.
**Virtual Memory:** Demand paging, Page Replacement algorithms, Allocation of frames, thrashing.
**I/O Management:** Principles of I/O Hardware: Disk structure, Disk scheduling algorithms.

**Text Books:**

1. Ekta Walia (2022), "Operating Systems Concepts", Khanna Publishing House.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), "Operating System Principles", Wiley India Private Limited.
3. Stallings (2006), "Operating Systems, Internals and Design Principles", 5thEdition , Pearson Education India.

**Reference Books:**

1. Andrew S. Tanenbaum, "Modern Operating Systems", 3rd Edition, Prentice Hall India.
2. Sumitabha Das, "UNIX Concepts and Applications", 4th Edition, Tata McGraw Hill.

## OPERATING SYSTEMS LAB

**Subject Code: BBCAS1-205** **L T P C**
**0 0 2 1**

**Course Outcomes:**

**CO1**: To implement scheduling of algorithms.
**CO2**: Understanding the concept of critical section problems.
**CO3**: Concepts of file allocation of frames.
**CO4**: Concept of Page Replacement algorithms.

1. Write C program to simulate the FCFS CPU Scheduling algorithm.
2. Write C program to simulate the SJF CPU Scheduling algorithm.
3. Write C program to simulate the Round Robin CPU Scheduling algorithm.
4. Write a C program to simulate Banker's Algorithm for Deadlock Avoidance.
5. Write a C program to implement the Producer-Consumer problem using semaphores.
6. Write a C program to illustrate the IPC mechanism using Pipes.
7. Write a C program to illustrate the IPC mechanism using FIFOs.
8. Write a C program to simulate Paging memory management technique.
9. Write a C program to simulate Segmentation memory management technique.
10. Write a C program to simulate the Best Fit contiguous memory allocation technique.
11. Write a C program to simulate the First Fit contiguous memory allocation technique.
12. Write a C program to simulate the concept of Dining Philosophers problem.
13. Write a C program to simulate the MVT algorithm.
14. Write a C program to implement FIFO page replacement technique.
15. Write a C program to write a C program for implementing sequential file allocation method.

## OBJECT ORIENTED PROGRAMMING USING JAVA

**Subject Code: BBCAC1-206** | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

**Course Objective:**

**CO1:** To introduce the object oriented programming system concepts
**CO2:** To introduce syntax and semantics of Java programming language
**CO3:** To develop modular programs using Java
**CO4:** To setup JDK environment to create, debug and run Java programs

### UNIT - I (12 Hrs.)

**Fundamentals of Object Oriented Programming:** Basic Concepts of Object Oriented Programming (OOP), Benefits and Applications of OOP, Java Evolution**:** Java Features, Difference between Java, C and C++, Java and Internet, Java Environment, Overview of Java Language: Introduction to Simple Java Program, Use of Comments and math functions, Applications of two classes, Java Program Structure, Java Tokens and statements, Implementing Java Programs and the JVM, Command Line Arguments.

### UNIT - II (11 Hrs.)

**Constants, Variables and Data Types:** Constants, Variables, Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Type casting.
**Operators & Expressions:** Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity.
**Decision Making, Branching & Looping:** Decision Making with Control Statements, Looping statements, Jump in loops, Labeled loops.

### UNIT - III (12 Hrs.)

**Classes, Objects and Methods:** Defining Class, Method Declaration, Constructors, Method Overloading, Method Overriding, Inheritance
**Arrays, Strings and Vectors:** 1D arrays, Creating an Array, 2D arrays, Strings, Vectors, Wrapper Classes, Enumerated Types
**Inheritance:** Defining, extending classes, and Implementing Interfaces. Multiple inheritance and polymorphism.

### UNIT - IV (10 Hrs.)

**Packages:** Basics of packages, System packages, Creating and accessing packages, creating user defined packages, Adding a class to a package.
**Exception Handling:** Using the main keywords of exception handling: try, catch, throw, throws and finally; Nested try, Multiple catch statements, Creating user-defined exceptions.

**Text Books:**

1. Balaguruswamy E. (2023), "Programming with JAVA: A Primer", 7th Edition, McGraw Hill Education.
2. Schildt, H. (2021), "Java: The Complete Reference", 12th Edition, McGraw-Hill Education.

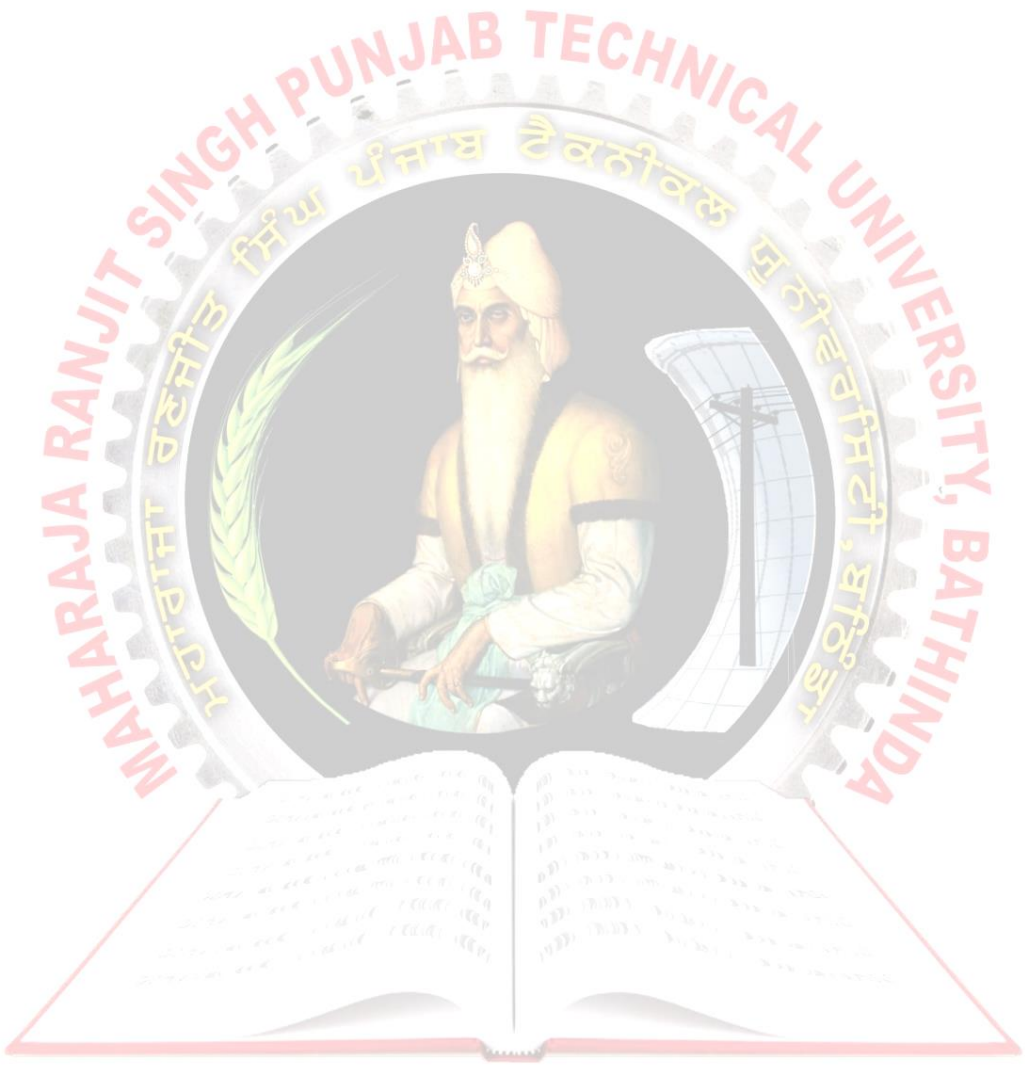
**Reference Books:**

1. Arunesh Goyal (2012), "The Essentials of JAVA", Khanna Book Publishing Company Private Limited.

2. Tanweer Alam (2015), "Core JAVA", Khanna Book Publishing Company Private Limited.
3. Y. Daniel Liang (2008), "Introduction to Java Programming", 7th Edition, Pearson.
4. S. Malhotra, S. Choudhary (2014), "Programming in Java", 2nd Edition, Oxford University Press.

**Web Resources**

1. https://www.w3schools.com/java/.
2. http://www.java2s.com/.
3. https://onlinecourses.nptel.ac.in/noc22_cs47/preview



## OBJECT ORIENTED PROGRAMMING USING JAVA LAB

**Subject Code: BBCAC1-207** **L T P C**
**0 0 4 2**

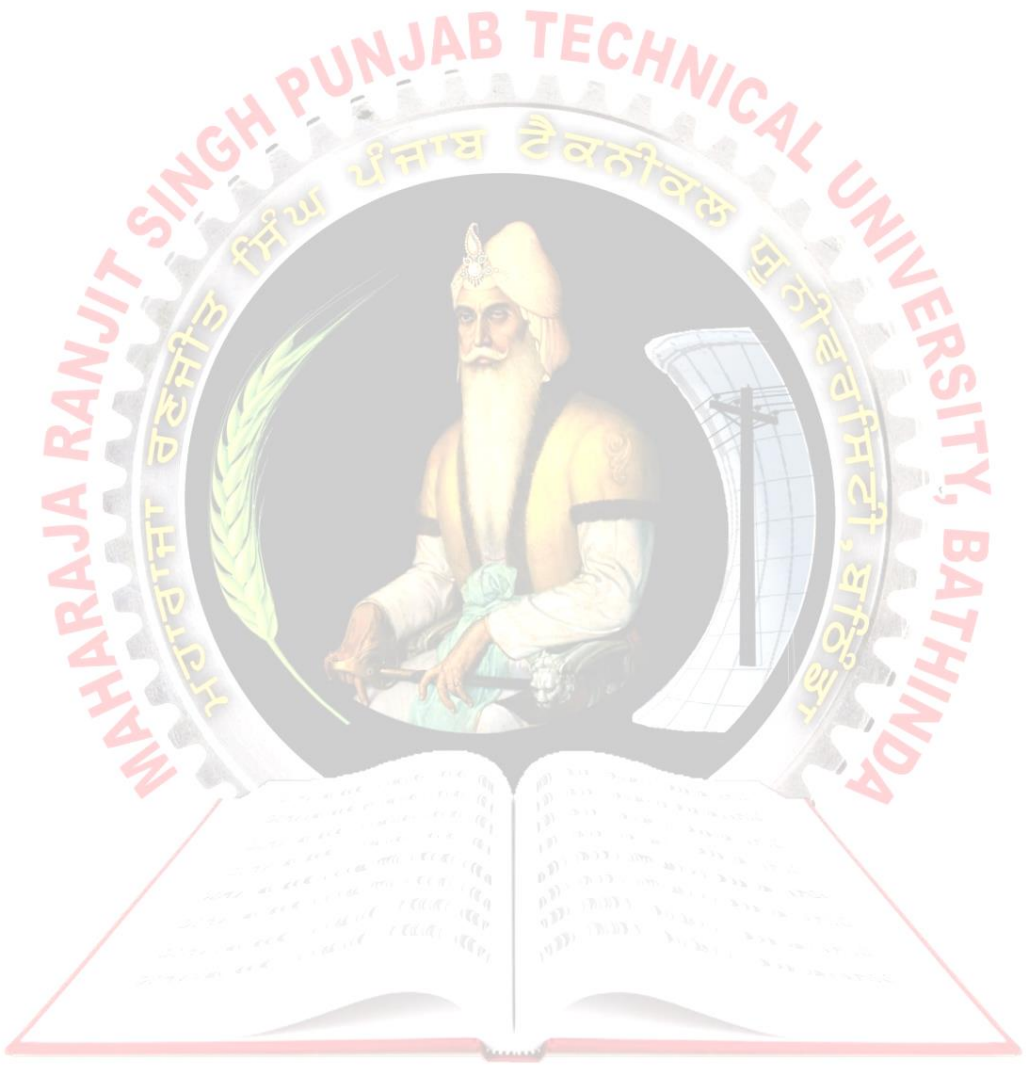
### Course Objective:

**CO1:** Develop Java programs using basic programming constructs, arrays, strings, and recursion.
**CO2:** Implement classes, objects, inheritance, and polymorphism in Java.
**CO3:** Develop Java programs using interfaces and packages.
**CO4:** Implement exception-handling mechanisms and develop robust Java applications.

### List of Experiments: -

1. Write a program to read two numbers from user and print their product.
2. Write a program to print the square of a number passed through command line arguments.
3. Write a program to send the name and surname of a student through command line arguments and print a welcome message for the student.
4. Write a java program to find the largest number out of n natural numbers.
5. Write a java program to find the Fibonacci series & Factorial of a number using recursive and non recursive functions.
6. Write a java program to multiply two given matrices.
7. Write a Java program for sorting a given list of names in ascending order.
8. Write a Java program that checks whether a given string is a palindrome or not.Ex:MADAM is a palindrome.
9. Write a java program to read n number of values in an array and display it in reverse order.
10. Write a Java program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations.
11. Create a JAVA class called Student with the following details as variables within it.
    a. USN, NAME, BRANCH, PHONE, PERCENTAGE
    b. Write a JAVA program to create n Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable headings.
12. Write a Java program that displays the number of characters, lines and words in a text.
13. Write a Java program to create a class called Shape with methods called getPerimeter() and getArea(). Create a subclass called Circle that overrides the getPerimeter() and getArea() methods to calculate the area and perimeter of a circle.
14. Write a Java program to create a class Employee with a method called calculateSalary(). Create two subclasses Manager and Programmer. In each subclass, override the calculateSalary() method to calculate and return the salary based on their specific roles.
15. Write a Java program using an interface called ‘Bank’ having function ‘rate_of_interest()’. Implement this interface to create two separate bank classes ‘SBI’ and ‘PNB’ to print different rates of interest. Include additionalm ember variables, constructors also in classes ‘SBI’ and ‘PNB’.
16. Write a Java package program for the class book and then import the data from the package and display the result.

17. Write a Java program for finding the cube of a number using a package for various data types and then import it in another class and display the results.
18. Write a Java program for demonstrating the divide by zero exception handling.
19. Write a Java program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
20. Create an exception subclass UnderAge, which prints “Under Age” along with the age value when an object of UnderAge class is printed in the catch statement. Write a class exceptionDemo in which the method test() throws UnderAge exception if the variable age passed to it as argument is less than 18. Write main() method also to show working of the program.



## WEB TECHNOLOGIES

**Subject Code: BBCAC1-208** **L T P C** **Duration: 15 Hrs.**
**1 0 0 1**

**Course Objectives:**

**CO1**: To understand the concepts and architecture of the World Wide Web, Markup languages along with Cascading Style Sheets.
**CO2**: To understand the concepts of event handling and data validation mechanisms.
**CO3**: To understand the concepts of embedded dynamic scripting on client and server-side Internet Programming and basic full stack web development.
**CO4**: To develop modern interactive web applications

### UNIT - I (4 Hrs.)

Introduction to HTML: Basic Structures of HTML, Header Tags, body tags, Paragraph Tags, Tags for FORM Creation, TABLE, FORM, TEXTAREA, SELECT, IMG, IFRAME FIELDSET, ANCHOR, Lists in HTML, Introduction to DIV tag, NAVBAR Design.

### UNIT - II (4 Hrs.)

Introduction to CSS, types, Selectors, and Responsiveness of a web page, Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding theGrid System in Bootstrap, Introduction to www, Protocols and Programs, Applications and development tools, web browsers, DNS, Web hosting Provider, Setting up of Windows/Linux/Unix web servers, Web hosting in cloud, Types of Web Hosting.

### UNIT - III (4 Hrs.)

Introduction to JavaScript: Functions and Events, Document Object model traversing using JavaScript. Output System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript, Date and String handling in JavaScript.

### UNIT - IV (3 Hrs.)

Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser, Introduction to AJAX, Purpose, advantages and disadvantages, AJAX based Web Applications and alternatives of AJAX, Introduction to XML: uses, Key concepts, DTD 8 schemas, XSL, XSLT and XSL Elements and transforming with XSLT. Introduction to XHTML, JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects.

**Text Books**

1. Laura Lemay (2016), "Mastering HTML, CSS & Java Script Web Publishing", BPB Publications.
2. Thomas A. Powell (2017), "The Complete Reference HTML & CSS" 5th, McGraw Hill.

**Reference Books:**

1. Silvio Moreto (2016), "Bootstrap 4 By Example", Ebook.
2. Tanweer Alam (2011), "Web Technologies", Khanna Book Publishing.

**Web Resources**

1. www.javatpoint.com
2. www.w3schools.com
3. https://www.geeksforgeeks.org/web-technology/

## WEB TECHNOLOGIES LAB

**Subject Code: BBCAC1-209**

**L T P C**
**0 0 2 1**

## Course Objectives:

**CO1:** Develop structured and responsive webpages using HTML and CSS.
**CO2:** Implement interactive web features using JavaScript.
**CO3:** Apply form validation and asynchronous communication using AJAX.
**CO4:** Create and process data using XML and JSON.

## List of Experiments:

1. Create your class time table using table tag.
2. Design a Webpage for your college containing description of courses, department, faculties, library etc. using list tags, href tags, and anchor tags.
3. Create web page using Frame with rows and columns where we will have header frame, left frame, right frame, and status bar frame. On clicking in the left frame, information should be displayed in right frame.
4. Create Your Resume using HTML, use text, link, size, colour and lists.
5. Create a Web Page of a super market using (internal CSS)
6. Use Inline CSS to format your resume that you have created.
7. Use External CSS to format your time table created.
8. Use all the CSS (inline, internal and external to format college web page that you have created.
9. Write a HTML Program to create your college website using for mobile device.

## INDIAN CONSTITUTION

**Subject Code: BBCAV1-210** **L T P C** **Duration: 30 Hrs.**
**2 0 0 2**

**Course Outcomes:**

**CO1:** Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure.

**CO2:** Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha).

**CO3:** State Government Mechanisms: Examine the powers of the Governor, Chief Minister, and the State Secretariat.

**CO4:** Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats.

**CO5:** Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections

**CO6:** Application of Knowledge: Apply constitutional principles to contemporary political issues and evaluate governance effectiveness.

**UNIT - I (7 Hrs.)**

**The Constitution - Introduction**

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

**UNIT - II (7 Hrs.)**

**Union Government**

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

**UNIT - III (9 Hrs.)**

**State Government**

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

**Local Administration**

- District Administration
- Municipal Corporation
- Zila Panchayat

**UNIT - IV (7 Hrs.)**

**Election Commission**

- Role and Functioning
- Chief Election Commissioner
- State Election Commission

**Suggested Learning Resources:**

1. Rajeev Bhargava, "Ethics and Politics of the Indian Constitution", Oxford University Press, New Delhi, 2008.

2. B. L. Fadia (2017), "The Constitution of India", Sahitya Bhawan.
3. D. D. Basu (2018), "Introduction to the Constitution of India", 23rd Edition, Lexis Nexis.

**Suggested Software/Learning Websites:**

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

**Cases**

- Rustom Cavasjee Cooper v. Union of India, (1970) 1 SCC 248
- State of Rajasthan v. Mohan Lal Vyas, AIR 1971 SC 2068 (confirmation of a private monopoly, not a violation of fundamental right)
- Mithilesh Garg v. Union of India, (1992) 1 SCC 168: AIR 1992 SC 221 (Right to carry on business, not breached when it is liberalised)
- Chintamanrao v. The State of Madhya Pradesh, AIR 1951 SC 118 (scope of reasonable restrictions in relation to trade and occupation)
- Cooverjee B. Bharucha v. Excise Commissioner, Ajmer, AIR 1954 SC 220 (the reasonableness of the restriction imposed may depend upon the nature of the business and prevailing conditions including public health and morality)
- T. B. Ibrahim v. Regional Transport Authority. Tanjore, AIR 1953 SC 79
- Harman Singh v. RTA, Calcutta, AIR 1954 SC 190
- Dwarka Prasad Laxmi Narain v. State of U.P., AIR 1954 SC 224
- State of Bombay v. R.M.D. Chamarbaugwala, AIR 1957 SC 699
- Parbhani Transport Coop. Society Ltd. v. Regional Transport Authority, Aurangabad, AIR 1960 SC 801
- State of Bombay v. R. M. D. Chamarbaugwala, (1957) S.C.R. 874,
- G.K.Krishnan vs State of Tamil Nadu, 1975 SCC (1) 375
- Automobile Transport (Rajasthan) Ltd. Vs State of Rajasthan, AIR 1962 SC 1406

# APPENDIX – III
# A Guide to Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.
We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

### 2.1. Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

### 2.2. Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program.
These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

### 2.3. Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships

### 2.4. Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

### 2.5. Proficiency Modules

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

### 2.6. Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

### 2.7. Visits to Local Areas

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

### 2.8. Familiarization with the Department/Branch & Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

## 3. Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

### 3.1. Initial Phase

| Day | Time | Activity |
|---|---|---|
| Day 0 | Whole Day | Students Arrive – Hostel Allotment (Preferably do pre-allotment) |
| Day 1 | 09:00 AM – 03:00 PM | Academic Registration |
| | 04:30 PM – 06:00 PM | Orientation |
| Day 2 | 09:00 AM – 10:00 AM | Diagnostic test (for English etc.) |
| | 10:00 AM – 12:25 PM | Visit to respective depts. |
| | 12:30 PM – 01:55 PM | Lunch |
| | 02:00 PM – 02:55 PM | Director's address |
| | 03:00 PM – 03:30 PM | Interaction with parents |
| | 03:30 PM – 05:00 PM | Mentor-Mentee Groups - Introduction within group. (Same as Universal Human Values Group) |

### 3.2. Regular Phase

After two days is the start of the Regular Phase of Induction. With this phase there would be regular program to be followed every day.

### 3.2.1. Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

**DAY 3 Onwards**

| Session | Time | Activity | Remarks |
|---|---|---|---|
| | 06:00 AM | Wake up Call | |
| I | 06:30 AM – 07:10 AM | Physical Activity (Mild Exercise / Yoga) | |
| | 07:15 AM – 08:55 AM | Bath, Breakfast etc. | |
| II | 09:10 AM – 10:55 AM | Creative Arts / Universal Human Values | Half the groups do creative arts |
| III | 11:00 AM – 12:55 PM | Creative Arts / Universal Human Values | Complementary Alternate Groups |
| | 01:00 PM – 02:25 PM | Lunch | |
| IV | 02:30 PM – 03:55 PM | Afternoon Session | See below |
| V | 04:00 PM – 05:00 PM | Afternoon Session | See below |
| | 05:00 PM – 05:25 PM | Break / Light Tea | |
| VI | 05:30 PM – 06:45 PM | Games / Special Lectures | |
| | 06:50 PM – 08:25 PM | Rest and Dinner | |
| VII | 08:30 PM – 09:25 PM | Informal Interactions (In hostels) | |

Sundays are off. Saturdays have the same schedule as above or have outings.

### 3.2.2. Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization with the Department/Branch & Innovations
2. Visits to Local Areas
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

| Session | Activity | Remarks |
|---|---|---|
| IV | Familiarization with Dept./Branch & Innovations | For 3 Days (Day 3 to Day 5) |
| IV, V and VI | Visit to Local Area | For 3 Days – interspersed (e.g. Saturdays) |
| IV | Lectures by Eminent People | As scheduled 3-5 lectures |
| IV | Literary (Play / Literature / Book Reading) | For 3-5 Days |
| V | Proficiency Modules | Daily, but only for those who need it. |

### 3.3. Closing Phase

| Day | Time | Activity |
|---|---|---|
| Last But One Day | 08:30 AM – 12:00 PM | Discussions and finalization of presentation within each group |
| | 02:00 AM -05:00 PM | Presentation by each group in front of 4 other groups besides their own (about 100 students) |
| Last Day | Whole Day | Examinations (if any). May be extended to last 2 days, in case needed. |

### 3.4. Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor- mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5-year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline.

Here we list some important suggestions which have come up and which have been experimented with:

#### 3.4.1. Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

#### 3.4.2. Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (up to fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.