Syllabi (First Year)

Of

Four Year Under Graduate Programme (FYUGP)

Of

# B.Sc. (Hons.) Programme in Computer Application and Cyber Security

(W.e.f. from Academic Year 2025-26)


Department Of Cyber Defence

Jharkhand Raksha Shakti University

Meur's Road SKIPA Premises, Ranchi

| **Course Title: Programming for Problem Solving** | |
|---|---|
| **Course Code:** FYCS-C101 | **Nature of Course: Core** |
| **Credit: 4** | **Classes Per Week: L: 3 T: 0 P: 2** |

**Course Objectives**

1. To provide foundational knowledge of computer programming using the programming language.
2. To enable students to understand algorithmic thinking and solve basic engineering problems computationally.
3. To introduce data handling, control structures, modular programming, and data structures.
4. To know the limitations of system during program execution.

**Course Outcomes (COs)**

After completion, students will be able to:

CO-1: To formulate simple algorithms for arithmetic and logical problems.

CO-2: To translate the algorithms to programs.

CO-3: To test and execute the programs and correct syntax and logical errors

CO-4: Solve real-world and science-based problems using C programming

CO-5: To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

## Syllabus

**Module I** **[10 L]**

Introduction to Components of a computer system: memory, processor, I/O, OS, compiler, interpreter, disks etc.

Introduction to algorithms and steps for logical/numerical problem-solving

Representation of Algorithm: flowcharts and pseudocode, Transition from algorithm to program: source code to executable, variables, data types memory locations, Syntax and Logical Errors in compilation, object and executable code.

**Module II** **[5L]**

Arithmetic expressions, precedence, associativity, Conditional statements: if, if-else, nested if, switch-case, Iteration using for, while, do-while; Writing and evaluating conditions
Use cases: number classification, sum of series, simple logic-based problems

**Module III** **[10 L]**

ID and 2D arrays: declaration, initialization, usage; Character arrays and string handling using standard library functions
Case studies on solving science-based problems using programming: Newton's Law, Kirchhoff's Law, Roots of equations

**Module IV** **[10L]**

Introduction to functions, built-in and user-defined; Parameter passing: call by value, arrays to functions; Concept of recursion: factorial, Fibonacci, Ackermann; Advanced recursion: quick sort, merge sort

**Module V** **[10L]**

Structures and arrays of structures; Introduction to pointers and dynamic memory allocation (malloc, free) ; Pointers with arrays and structures; Self-referential structures and basic singly linked list; File handling: reading/writing from text files (fopen, fscanf, fprintf, etc.)

**Text Books:**

1. Problem solving and Program design in C: Jery R Hanly Paerson Education.7th Edison
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

**References:**

1. R.G.Dromey, How to Solve it by Computer, Pearson Education Reference Books
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice

## Practicals:

1. **Write a program to:**

a) Check whether a number is a prime number.
b) Check whether a number belongs to the Fibonacci sequence.
c) Determine if a given year is a leap year and list leap years between two years.

2. **Write a program to:**

a) Approximate sin(x) using the trigonometric series expansion until the term is less than $10^{-5}$. (Test for x = 1, 2, 3)

b) Generate every 3rd integer from 2 to less than 150 and calculate the sum of numbers divisible by 5.
c) Calculate the recursive sum of even numbers: S = 2 + 4 + 6 + ... + 2N

3. **Write a program to:**
a) Check if a number is a palindrome.
b) Convert a decimal number into binary, octal, decimal, and hexadecimal.
c) Find the greatest common divisor (GCD) of two integers.

4. **Write a program to:**
a) Read a number and print its digits as words. Example: 123 → one two three
b) Simulate a simple calculator that performs operations: +, −, *, /, %
c) Use a ternary operator to find the maximum among three numbers.

5. **Write a program to:**
a) Print the following number pattern:

```
      11
    11 10 11
  11 10 9 10 11
11 10 9 8 9 10 11
```

b) Display all leap years between two given years (if not covered in #1).
c) Generate basic logic-based pattern outputs.

6. **Write a program to:**
a) Read a string and replace:
   i. Uppercase ↔ Lowercase
   ii. Digits → 0
   iii. Special characters → *
b) Remove all instances of a character from a string using pointers.
c) Sort a list of strings using:
   i. 2D character arrays
   ii. Array of pointers

7. **Write a program to:**
a) Swap two values without using a third variable.
b) Use pointers to read and reverse a string.
c) Calculate string length without using strlen.

8. **Write a program to:**
a) Multiply two matrices and display the result.
b) Find the transpose of a matrix and print both original and transpose.
c) Compute and display the row and column-wise sum of a matrix.

9. **Write a program to:**
a) Check whether a given matrix is upper or lower triangular.

b) Count and display zero and non-zero elements in a matrix.
c) Calculate trace and diagonal elements.

10. **Write a program to:**
a) Sort an array using Bubble Sort implemented with pointers.
b) Compare and sort elements using pointer arithmetic.
c) Use pointer functions to simplify logic in sorting routines.

11. **Write a program to:**
a) Create a student record system using structures (name, roll, GPA, fees).
b) Update fees (−25%) for students with GPA > 8.5
c) Display records before and after update.

12. **Write a program to:**
a) Create a structure for hotel records with fields such as name, location, grade, and room charge.
b) Display all hotels of a specific grade sorted by room charge.
c) Display hotels where the room charge is below a given threshold.

| **Course Title: Digital System Design** | |
|---|---|
| **Course Code:** FYCS - AC102 | **Nature of Course: Associated Core** |
| **Credit: 4** | **Classes Per Week: L: 3 T: 0 P: 2** |

**Course Objective:**

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various digital electronic circuits.
3. To identify and prevent various hazards and timing problems in a digital design.
4. To identify requirements for a design application and propose a cost-effective solution.
5. To develop skill to build, and troubleshoot digital circuits.

**Course Outcomes:**

At the end of the course student will be able to:

CO-1: Understand working of logic families and logic gates.
CO-2: Analyze and design various combinational logic circuits
CO-3: Design and implement sequential logic circuits
CO-4: Understand the process of Analog to Digital conversion and Digital to Analog conversion

## Syllabus

**MODULE 1** **[9 Lectures]**

**FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes. Characteristics of digital**.** ICs, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic

**MODULE 2** **[10 Lectures]**

**COMBINATIONAL DIGITAL CIRCUITS**

Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions. Multiplexer, De-Multiplexer/Decoders, Adders, Subtractions, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices.

**MODULE 3** **[10 Lectures]**

**SEQUENTIAL CIRCUITS AND SYSTEMS**

A 1-bit memory, the clocked SR flip flop, J- K-T and D-types flip-flops, applications of flip-flops, shift registers, applications of shift registers, ripple(Asynchronous) counters, synchronous counters, Synchronous Sequential Circuits Design, Asynchronous Sequential Circuits Design, Hazards in Sequential Circuits.

**MODULE 4** **[9 Lectures]**

**A/D AND D/A CONVERTER**

An introduction, Digital to analog converters, D/A converter, specifications for D/A converters, examples of D/A Convertors IC, sample and hold circuit, analog to digital converters, example of A/D converter ICs.

**MODULE 5** **[10 Lectures]**

**SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES:**

Memory organization and operation, expanding memory size, classification and characteristics of memories, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge coupled device memory (CCD), ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

**TEXTBOOKS :**

1. Modern Digital Electronics by R. P. Jain, McGraw Hill Education, 2009
2. Digital Logic and Computer Design by M. M. Mano, Pearson Education India, 2016
3. Fundamentals of Digital Circuits by A. Anand Kumar, PHI Pvt. Ltd., 2009
4. Digital Electronics by S. Salivahanan, Vikas Publishing House Pvt. Ltd., 2010.

**REFERENCES**

1. Digital computer fundamentals by Digital computer fundamentals, McGraw-Hill,1977
2. Digital Electronics by Roger L. Tokenism, McGraw-Hill Science/Engineering/Math,1993

## Practical:

1. Simulate AND, OR, NOT, NAND, NOR, XOR gates.
2. Simplify Boolean expressions using K-map and implement the simplified circuit.
3. Build a convertor for Binary to Decimal or Binary Adder.
4. Simulate half adder and full adder circuits using switches.
5. Implement MUX/DMUX using logic gates.
6. Design and simulate BCD input with 7-segment output.
7. Build flip-flop circuits and observe output behaviour with clock input.
8. Implement ripple counter and synchronous up counter using flip-flops.
9. Simulate data shifting through flip-flops.

10. Simulate digital to analog conversion and observe analog output.
11. Simulate analog to digital conversion and display binary output.
12. Use the built-in RAM module to write and read data from specific addresses.

| **Course Title: Web Design Fundamentals** | |
|---|---|
| **Course Code:** FYCS-SEC104 | **Nature of Course: Skill Enhancement Course** |
| **Credit: 3** | **Classes Per Week: L: 2 T: 0 P: 1** |

**Course Objectives**

1. Understand how the web works and how websites are built.
2. Learn to create structured, styled, and interactive web pages.
3. Develop dynamic web applications using PHP and MySQL.
4. Understand client-server interaction and database operations.
5. Apply CRUD functionality to a working web application.

**Course Outcomes**

CO-1: Develop structured and semantic web pages using HTML.

CO-2: Apply styling techniques using CSS and add interactivity with JavaScript.

CO-3: Implement backend scripting using PHP and securely interact with databases using PHP PDO.

CO-4: Design and manage MySQL databases and perform CRUD operations.

CO-5: Integrate frontend and backend components using XAMPP to create dynamic, database-driven web applications.

CO-6: Build and deploy a mini-project applying complete full-stack web development concepts.

## Syllabus

**MODULE 1: HTML – BUILDING THE STRUCTURE 6L**

Introduction to HTML and the role of markup languages, HTML document structure (<!DOCTYPE>, <html>, <head>, <body>), Common tags: headings, paragraphs, lists, links, images, tables, Forms and form elements (<input>, <textarea>, <select>, etc.), Semantic HTML (<article>, <section>, <nav>, <footer>), Best practices in writing clean, accessible HTML

**MODULE 2: CSS AND JAVASCRIPT – STYLING AND INTERACTIVITY 6L**

CSS: Syntax and selectors, Box model, Flexbox, Grid, Responsive design, JavaScript: Variables, control structures, functions, DOM manipulation, form validation.

**Module 3: PHP and PHP PDO – Backend Scripting 6L**

PHP syntax, variables, arrays, functions, Form handling with PHP, Introduction to PHP Data Objects (PDO), Connecting to databases securely using PDO

**MODULE 4: MYSQL – DATABASE MANAGEMENT AND QUERIES 6L**

Introduction to relational databases, creating databases and tables using MySQL, SQL basics: SELECT, INSERT, UPDATE, DELETE, JOIN, Using PHP (PDO) to interact with MySQL

**MODULE 5: RUNNING XAMPP SERVER & CRUD OPERATIONS 6L**

Installing and running XAMPP, connecting frontend and backend using PHP, Full implementation of CRUD operations, Mini-project: student or product manager application

## Practical

1. Create a Personal Web Page Using HTML, include name, photo, hobbies, and a contact form.
2. Create a Registration Form use various input types and validation attributes
3. Create a Web Page using HTML and apply styling using CSS. Apply Flexbox or Grid and external stylesheets.
4. Create a webpage using HTML and CSS. Add Interactivity with JavaScript and validate form inputs and manipulate DOM.
5. Create a Multi-page Website and include navigation tabs and consistent CSS layout.
6. Create a webpage using HTML CSS and JS. Introduction PHP to relevant sections and Display Dynamic Content and also to process and display form inputs.
7. In the last practical files use PHP Form Handling with Validation to sanitize and validate server-side form data.
8. Use MySQL Database and create table using queries- Create database `student_db` and table `students`.
9. The database created in last practical perform Insert and Retrieve Data Using PHP & PDO form to insert and to display student data
10. The 'student.db' databased can be used here to implement CRUD Operations using PHP scripts for Create, Read, Update, Delete
11. Develop a Mini Project with XAMPP- Student Registration System or Inventory Manager
12. Deploy the completed Project Locally Using XAMPP Test application and debug using browser

| **Course Title: Foundations of Indian Knowledge Systems** | |
|---|---|
| **Course Code:** FYCS – IKS105 | **Nature of Course: Indian Knowledge System** |
| **Credit: 2** | **Classes Per Week: L: 2 T: 0 P: 0** |

**Course Objectives:**

1. To introduce foundational Indian philosophies, logic, and mathematical contributions relevant to modern computing.
2. To promote ethical awareness using ancient Indian frameworks for responsible technology usage.
3. To bridge Indian traditional knowledge with emerging cyber technologies.

**Course Outcomes (COs):**

By the end of this course, students will be able to:

CO-1. Understand and articulate the core principles of Indian Knowledge Systems and their relevance to computing and cybersecurity.

CO-2. Apply ancient Indian logical and mathematical frameworks (e.g., Vedic Mathematics, Nyaya) to modern computational thinking and algorithms.

CO-3. Evaluate and integrate ethical principles from Indian traditions into digital and cybersecurity practices.

CO-4. Analyze the potential of IKS for sustainable, community-centric, and culturally aligned technology solutions in cybersecurity and computing.

## Syllabus

**Module I: Foundations of Indian Knowledge System (8 Hours)**

Overview and relevance of IKS in contemporary science and technology; Ancient Indian education systems: Nalanda, Takshashila, Gurukul; Six Darshanas (schools of philosophy) with emphasis on logic (Nyaya); Writing systems and early knowledge codification (Brahmi, Devanagari, Grantha)

**Module II: Ancient Indian Mathematics and Logic (8 Hours)**

Introduction to Vedic Mathematics: key sutras and their computational relevance; Pingala's binary system and its relationship with modern computing; Aryabhata, Bhaskaracharya, and ancient algorithmic techniques; Indian combinatorics and early principles of recursion

**Module III: Ethical Dimensions in Indian Traditions (8 Hours)**

Indian frameworks of ethics: Dharma, Satya, Ahimsa, and Nishkama Karma; Cyber ethics and digital responsibility through the lens of ancient texts; Data privacy and integrity: lessons

from Manusmriti and Arthashastra; Role of truthfulness, restraint, and transparency in cyber practices

**Module IV: Applications and Integration with Modern Technologies (8 Hours)**
IKS-based approaches to cybersecurity and governance; Decentralization models (e.g., Panchayati Raj) and parallels in network security; Indigenous technology practices: sustainability and community resilience; Case studies: Use of Vedic logic in AI and decision systems

**Suggested Readings & Resources:**

1. Vedic Mathematics – Swami Bharati Krishna Tirtha
2. The Indian Knowledge System: An Introduction – Kapil Kapoor
3. Nyaya-Vaisheshika: Logic and Physics in Ancient India
4. UGC and AICTE IKS Curriculum Framework
5. Research papers on Pingala's binary system and Sanskrit algorithmic logic

| **Course Title: Universal Human Values-I** | |
|---|---|
| **Course Code:** FYCS - VAC106 | **Nature of Course: Value Added Course** |
| **Credit: 2** | **Classes Per Week: L: 2 T: 0 P: 0** |

**Course Overview:**

Yoga is an ancient practice that incorporates gentle exercise, breath control and meditation. The health benefits of regular yoga practice may include lowering blood pressure, improved posture and circulation, and a sense of wellbeing. The word health refers to a state of complete emotional, mental, and physical well-being. People may be able to maintain or improve their health by eating a balanced diet, exercising regularly, and connecting with others. The relationship between yoga and health is multifaceted, encompassing physical, mental, and emotional well-being. Through its integration of physical postures, breathing exercises, meditation, and mindfulness practices, yoga offers a holistic approach to enhancing overall health. It improves physical fitness, flexibility, and cardiovascular health while reducing stress, and anxiety, and promoting emotional balance.

**Course Outcomes:**

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

CO-1: Understand the philosophy and science of yoga

CO-2: Demonstrate basic yoga postures (asanas), breathing techniques (pranayama), and meditation

CO-3: Apply yoga practices for stress relief, mental clarity, and enhanced well-being.

CO-4: Integrate yoga into daily routines for lifelong wellness.

## Syllabus

**Module I** **(15 Hours)**

**Introduction to Yoga:** Definition and meaning of Yoga, History and origin of Yoga, Types and schools of Yoga (Karma, Bhakti, Raja, Jnana), Yoga in daily life: Benefits and relevance. Asanas Pranayama & Breathing Techniques: Warming-up exercises and Surya Namaskar, Padmasana, Bhujangasana, Halasana, Shalabhasana, Dhanurasana, Vajrasana, Chakrasana, Shavasana, Pawanmuktasana, Mandukasana and Uttanpadasana. Pranayama and its health benefits- Bhastrika, Kapalbhati, Bhya pranayama, Anulom vilom, Bhramari, Udgeeth, Nadishodhana

**Module II** **(15 Hours)**

**Meditation, Diet, Lifestyle:** Basics of meditation: Mindfulness, body awareness, mantra meditation, Techniques: Yoga Nidra, Om chanting, Trataka (candle gazing), Managing stress

and anxiety through meditation, Nutrients and their function in maintaining good health, Yogic diet: Sattvic, Rajasic, Tamasic foods.

**Health & Wellness Concepts:** Meaning, dimensions (Physical, mental, emotional, and spiritual dimensions) and approaches to health and wellness, Factors influencing health, Indicators of good health and poor health, Meaning & Importance of Physical education, Components of physical fitness and wellness.

**Suggested Readings**

1. B.K.S Iyengar (2000), Yoga Deepika, Vivekanand Kendra Publisher Bangalore
2. A.K. Upal, Principles of sports training (2001), Friends Publication, Delhi
3. B. C. Rai, Health Education and Hygiene, Prakashan Kendra, Lucknow
4. K. K. Verma, Health and Physical Education (2005), Prakash Brothers, Ludhiana
5. Ajmer Singh et al, Modern Textbook of Physical Education, Health and Sports (2022), Kalyani publishers, Ludhiana
6. B. N. Ghose, A Treaties of Hygiene and Public Health, Scientific Publishing Co., Kolkata
7. M. Zimmermann, Handbook of Nutrition (2007), Saurabh Printers Pvt. Ltd.
8. Kumud Khanna et al, Nutrition and Dietetics (2001), Phoenix Publishing house Pvt. Ltd.

| **Course Title: Hindi** | |
|---|---|
| **Course Code:** FYCS - AEC107 | **Nature of Course: Ability Enhancement Course** |
| **Credit: 2** | **Classes Per Week: L: 2 T: 0 P: 0** |

**Course Overview**

यह कार्यक्रम छात्रों को आदिकालीन हिंदी साहित्य से लेकर आधुनिक हिंदी साहित्य तक, हिंदी साहित्य की नवीनतम प्रवृत्तियों से अवगत कराता है। इस कार्यक्रम का मुख्य उद्देश्य छात्रों को हिंदी भाषा साहित्य से संबंधित विभिन्न काव्य धाराओं, जैसे- प्रारंभिक काव्य, भक्ति काव्य, रीतिकालीन काव्य और आधुनिक युग का काव्य तथा इस युग के कवियों की रचनाओं का ज्ञान प्रदान करना है। छात्रों में वैज्ञानिक दृष्टिकोण, तार्किक बुद्धि का विकास किया जाना चाहिए, ताकि वे देश के प्रबुद्ध नागरिक बन सकें। इस पाठ्यक्रम के माध्यम से, छात्र आत्मनिर्भर बनकर अपने हृदय, मन और बुद्धि को सुदृढ़ कर सकेंगे और देश के विकास में सहायक बन सकेंगे। इस पाठ्यक्रम का गठन इस देश का एक आदर्श नागरिक बनने के उद्देश्य से किया गया है।

**Course Outcomes:**

पाठ्यक्रम के सफल समापन के बाद, छात्र सक्षम होंगे ।

CO-1: कविता के भावों को समझकर विद्यार्थी संवेदनशील, मूल्यवान बनेंगे।

CO-2: हिंदी साहित्य के समृद्ध इतिहास से होंगे परिचित ।

CO-3: छात्र साहित्यिक शब्दों को सीख सकेंगे ।

CO-4: एक अच्छा व्यक्ति बन सकेगा ।

**Syllabus**

**Module I (15 Hours)**

हिन्दी की ऐतिहासिक पृष्ठभूमि, आधुनिक भारतीय आर्य भाषाएं और उनका वर्गीकरण, हिन्दी का भौगोलिक विस्तार, हिन्दी की उपभाषाएं, हिन्दी का भाषिक स्वरूप, हिन्दी ध्वनियों के वर्गीकरण का आधार, हिन्दी भाषा प्रयोग के विविध रूप,

हिन्दी – वाक्य रचना, देवानागरी लिपि, प्रमुख रस, अलंकार, रीति, ध्वनि, वक्रोक्ति और औचित्य, रस निष्पत्ति

**Module II (15 Hours)**

हिन्दी साहित्येतिहास दर्शन, हिन्दी साहित्य के इतिहास लेखन की पद्धतियां, हिन्दी साहित्य का काल विभाजन और नामकरण, आदिकालीन हिन्दी का साहित्य, भक्तिकाल, रीतिकाल, आधुनिक काल, हिन्दी गद्य , समकालीन कविता, हिन्दी उपन्यास, हिन्दी कहानी, हिन्दी निबन्ध, अनुच्छेद लेखन , ज्ञापन लेखन, पत्र लेखन, कम्पूटर और हिन्दी, हिन्दी की संवैधानिक स्थिति

**Suggested Readings/ संस्तुत पुस्तकें-**

1. हिन्दी कहानी का विकास – मधुरेश
2. गद्य साहित्य - रामचन्द्र तिवारी
3. कहानियों की शिल्प विधि का विकास- लक्ष्मी नारायण लाल
4. हिन्दी निबन्ध का विकास - डॉ. ओंकारनाथ शर्मा
5. हिन्दी निबन्ध - प्रभाकर माचवे
6. हिन्दी साहित्य का वैज्ञानिक इतिहास - गणपतिचन्द्र गुप्त
7. हिन्दी साहित्य उद्भव और विकास - हजारी प्रसाद द्विवेदी
8. भाषा विज्ञान और हिन्दी भाषा - डॉ. नरेश मिश्र

| **Course Title: Data Structure** | |
|---|---|
| **Course Code:** FYCS-C201 | **Nature of Course: Core** |
| **Credit: 4** | **Classes Per Week: L: 3 T: 0 P: 2** |

**Course Objectives**

1. To become familiar with the fundamental techniques of algorithm analysis.
2. To understand the basic concepts of arrays, stacks, queues, linked lists, trees, and graphs.
3. To explore and apply various searching and sorting techniques.
4. To implement linear and non-linear data structures, as well as search and sort algorithms.
5. To evaluate the impact of data structure choices on the performance and efficiency of programs.

**Course Outcomes (COs)**

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

CO-1: Define various linear and non-linear data structures such as stacks, queues, linked lists, trees, and graphs.

CO-2: Explain operations including insertion, deletion, traversal, searching, and sorting on different data structures.

CO-3: Design suitable data structures and implement their associated operations.

CO-4: Analyze the performance and complexity of operations like searching and sorting.

Co-5: Justify the selection of appropriate data structures for solving specific computational problems.

## Syllabus

**Module I** **[9 L]**

**Basic Concepts**

Definition and basics of: Data Structure, ADT, Algorithms, Time and Space Complexity, Asymptotic Notations (O, θ, Ω), Time complexity computation of non-recursive algorithms (like Matrix addition, Selection sort – using step count), Array – basic operations, concept of multi-dimensional array, Polynomial operations using Array, Sparse Matrix.

**Module II** **[9L]**

**Stack and Queue**

Stack ADT: basic operations, Queue ADT: basic operations, Circular Queue, Evaluation of Expressions, Another application or Mazing Problem.

**Module III**

**Linked List** **[9 L]**

Singly Linked List: concept, representation and operations, Circular Linked List, Polynomial and Sparse Matrix operations using LL, Doubly Linked List: basic concept.

**Module IV** **[9L]**

**Tree and Graph**

Basic concepts and terminologies, Binary Search Tree and Heap, Disjoint Set, Graph: concept Page 63 of 443 and terminologies, Concept of BFS, DFS, Spanning Tree, Connected Components.

**Module V** **[9L]**

**Searching and Sorting**

Sequential Search and Binary Search, Insertion Sort, Heap Sort, Radix Sort, External Sorting: k-way merging approach.

**Text book:**

1. Sahni Horwitz, Freed Anderson, Fundamentals of Data Structures in C, 2nd Edition (or latest), University Press (T1).
2. Baluja G S, "Data Structure through C", Ganpat Rai Publication, New Delhi, 2015.
3. Pai G A V, "Data Structures and Algorithms: Concepts, Techniques and Applications", 2ndEdn, Tata McGraw-Hill, 2008.
4. Horowitz E., Sahni S., Susan A., "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2010.

**Reference books:**

1. Thareja Reema, Data Structures Using C, 2nd Edition, Oxford University Press(R1).
2. Tanenbaum, Langsam, Augenstein, Data Structures using C, Pearson (R2) .

## Practical:

**1. Write programs for Basic Array Operations**

**(a)** Write a program to perform basic array operations: creation, display, insertion, and deletion.

**(b)** Write a program to implement polynomial addition and sparse matrix representation using arrays.

**2. Write programs to Analyze Algorithm Complexity**

**(a)** Write a program to compute time complexity (step count) of matrix addition.

**(b)** Write a program to perform selection sort and analyze time complexity.

**3. Write programs to Implement Stack using Arrays**

**(a)** Write a menu-driven program to implement stack operations using arrays.
**(b)** Write a program to convert an infix expression to postfix and evaluate it using stack.

**4. Write programs for Queue Implementations**
**(a)** Write a program to implement queue operations using arrays.
**(b)** Write a program to implement circular queue using arrays.

**5. Write programs to Implement Stack and Queue using Linked List**
**(a)** Write a program to implement stack using linked list.
**(b)** Write a program to implement queue using linked list.

**6. Write programs for Singly Linked List Operations**
**(a)** Write a program to create, insert, delete, and display a singly linked list.
**(b)** Write a program to sort and reverse a singly linked list.

**7. Write programs for Doubly and Circular Linked Lists**
**(a)** Write a program to implement a circular linked list with insertion and deletion.
**(b)** Write a program to implement a doubly linked list with display functionality.

**8. Write programs for Polynomial and Sparse Matrix using Linked Lists**
**(a)** Write a program to represent a polynomial using linked list.
**(b)** Write a program to add two polynomials using linked lists.

**9. Write programs to Implement Binary Trees**
**(a)** Write a program to create a binary search tree with insert, delete and search operations.
**(b)** Write a program for non-recursive in-order, pre-order and post-order traversal of a binary tree.

**10. Write programs for Advanced Tree Structures**
**(a)** Write a program to implement AVL tree with insertion.
**(b)** Write a program to implement heap and perform heap sort.

**11. Write programs for Searching and Sorting**
**(a)** Write a program to perform linear and binary search using arrays.
**(b)** Write a program to implement radix sort and insertion sort.

**12. Write programs for Graph and Disjoint Set**
**(a)** Write a program to represent a graph using adjacency matrix and perform BFS & DFS.
**(b)** Write a program to find spanning tree and connected components using disjoint set operations.

| **Course Title:** Operating System | |
|---|---|
| **Course Code:** FYCS-AC202 | **Nature of Course: Associated Core** |
| **Credit: 4** | **Classes Per Week: L: 3 T: 0 P: 1** |

**Course Objectives:**

1. To introduce the fundamentals and types of operating systems and their characteristics.
2. To make students understand the concept of processes and their communications and its problems.
3. To create an understanding of various types of scheduling (Process, and disk).
4. To create an awareness about deadlocks and its mechanisms for prevention.
5. To understand the concept of memory management.

**Course Outcomes:**

At the end of the course student will have ability to:

CO-1: Familiarize and compare different operating systems.

CO-2: Understand and differentiate between program, process, and threads.

CO-3: Implement basic process scheduling algorithms.

CO-4: To understand and implement deadlock avoidance algorithms.

CO-4: Familiarize with disk scheduling and memory management by the concept of paging.

## Syllabus

**MODULE 1** **[8 Lectures]**

**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS – Layered Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.

**MODULE 2** **[8 Lectures]**

**Processes:** Definition, Process Relationship, Different states of a Process, Process, Inter Process Communication, Process Control Block (PCB), Context switching.

**Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

**Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

**MODULE 3** **[9 Lectures]**

**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

**MODULE 4** **[10 Lectures]**

**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging, Segmentation.

**Virtual Memory**:

Basics of Virtual Memory– Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU),Thrashing.

**MODULE 5** **[10 Lectures]**

**File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

**Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks, RAID Structure.

**TEXT BOOKS**

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. "Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing.
4. Applied Operating Systems Concepts: by Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 5th ed. John Wiley & Sons.

**REFERENCE BOOKS**

1. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
2. Design of the UNIX Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall.

## Practical:

1. Create a program that demonstrates process creation using fork(). Modify the program to spawn multiple children processes and waits for each to complete using wait (). Extend the program that demonstrates the use of getpid() and getppid() to display process IDs.
2. Write two programs: one sends a string to the other via a named or unnamed pipe. The receiver should display the received string on the console.
3. Implement a multi-threaded program that creates and runs multiple threads which increment a global variable concurrently. Ensure each thread prints its own thread ID.
4. Write a program to simulate memory allocation using first fit, best fit, and worst fit strategies. Accept a series of memory requests and show the allocation results.
5. Write a program that inputs resource requests and allocations, builds the resource allocation graph, and determines if a deadlock exists.
6. Write a program to implement FCFS, Round Robin scheduling algorithm.
7. Write a program to implement SJF, SRTF scheduling algorithm.
8. Write a program to implement preemptive and non-preemptive based priority scheduling algorithm
9. Write a program to calculate sum of n number using thread library.
10. Write a program for page replacement policy using LRU, FIFO.
11. Write a program to implement reader/writer problem using semaphore.
12. Write a program to implement Banker's algorithm for deadlock avoidance.

| **Course Title: Cybersecurity & Ethical Hacking** | |
|---|---|
| **Course Code:** FYCS-SEC204 | **Nature of Course: Skill Enhancement Course** |
| **Credit: 3** | **Classes Per Week: L: 2 T: 0 P: 1** |

**Course Objectives**

1. To understand the principles of cybersecurity and identify common threats and vulnerabilities.
2. To learn ethical hacking methodologies and tools.
3. To provide hands-on experience in penetration testing and securing systems.
4. To understand legal and ethical issues in cybersecurity.
5. To prepare students for careers in information security.

**Course Outcomes**

CO-1: Understand foundational concepts of cybersecurity and threat models.
CO-2: Identify and analyze vulnerabilities in computer systems and networks.
CO-3: Apply tools and techniques used in ethical hacking and penetration testing.
CO-4: Perform security assessments and recommend mitigation strategies.
CO-5: Demonstrate awareness of cybersecurity laws, policies, and ethical responsibilities.

## Syllabus

**MODULE 1: INTRODUCTION TO CYBERSECURITY [8L]**

Introduction to Cybersecurity: CIA Triad, Threats and Attacks: Malware, Phishing, DoS, Ransomware, Security Policies and Procedures, Cryptography Basics: Symmetric, Asymmetric, Hashing, Authentication and Access Control, Cyber Laws and Ethics (e.g., IT Act, GDPR, etc.)

**MODULE 2: SYSTEM AND NETWORK SECURITY [8L]**

Operating System Security: Hardening, User Privileges, Network Security Concepts: Firewalls, IDS, IPS, Port Scanning & Network Mapping (Nmap, Wireshark), Network Protocol Vulnerabilities (ARP spoofing, DNS poisoning), Secure Network Architectures

**MODULE 3: ETHICAL HACKING FUNDAMENTALS [6L]**

Introduction to Ethical Hacking: Phases & Types, Foot printing and Reconnaissance (Passive & Active), Scanning and Enumeration, Vulnerability Analysis Tools (Nessus, OpenVAS), Legal Framework for Ethical Hacking

**MODULE 4: WEB AND APPLICATION SECURITY [8L]**

Web Application Vulnerabilities ( SQL Injection, XSS, CSRF, File Inclusion, etc), Secure Coding Practices, Session Management & Authentication Flaws, Tools: Burp Suite, OWASP ZAP, Case Studies of Major Web Attacks.

**MODULE 5: PENETRATION TESTING & INCIDENT RESPONSE [6L]**

Penetration Testing Life Cycle, Metasploit Framework and Exploits, Social Engineering Techniques, Post-Exploitation Techniques and Reporting, Introduction to Digital Forensics, Incident Response and Security Audits

**TEXTBOOKS**

1. Network Security Essentials: Applications and Standards, William Stallings, Pearson.
2. Security in Computing, Charles P. Pfleeger, Pearson.
3. Introduction to Computer Security, Michael T. Goodrich & Roberto Tamassia, Pearson.
4. Behrouz A. Forouzan – Cryptography and Network Security, McGraw-Hill.
5. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.

**REFERENCE BOOKS**

1. Kali Linux Revealed – Mastering the Penetration Testing Distribution, Offensive Security.
2. Kevin Mitnick – The Art of Invisibility and The Art of Deception (Cybersecurity culture & awareness)
3. Red Team Tools & Blue Team Blogs – Various GitHub and community-curated resources

## Practical

1. Launch Kali Linux (bare-metal or VM). Familiarize yourself with the Kali Linux environment and its pre-installed tools. Explore and categorize tools: Information Gathering, Vulnerability Analysis, Web Application, etc.

2. Utilize the Namp tool to perform Network Scanning Perform host discovery and port scanning on a local network. Use nmap for basic scans, version detection, and OS fingerprinting. Scan a local network to identify active hosts and open ports.

3. Utilize Wireshark to Capture Packets and Analyze and Monitor the local network traffic. Filter for specific protocols like HTTP, DNS, FTP. Identify possible sensitive data leaks.

4. Utilize the OpenVAS/Nessus for Vulnerability Scanning. Identify security vulnerabilities in a given host. Perform a full vulnerability scan on a test VM (e.g., Metasploitable) and generate and interpret the vulnerability report.

5. Simulate SQL injection by serring up a DVWA(Damn Vulnerable Web App) in XAMPP and perform a manual SQL injection attack to bypass login. Suggest and implement basic input validation as a mitigation technique to suck kind of attacks.

6. Perform a Cross-Site Scripting (XSS) attack on a DVWA by injecting malicious JavaScript into its input field. Demonstrate the reflected and stored XSS.

7. Perform a brute force password cracking using Jhon the Ripper and Hydra(e.g. from /etc/shadows) on FTP or SSH setups.

8. Set up Metasploitable VM as target and use Metasploit to exploit known vulnerabilities. Use Metasploit to find and exploit vulnerabilities (e.g., vsftpd backdoor) and gain shell access and document the process.

9. Utilize a Social Engineering Toolkit (SET) to create a fake login page and simulate phishing attack. Analyze how attackers collect credentials.

10. Utilize app like WebGoat or DVWA to create a vulnerable app. Run OWASP ZAP scanner and intercept HTTP requests to identify web vulnerabilities and fix the reported vulnerabilities.

11. Perform Host Hardening on a Linux system by disabling unnecessary services and open ports. Configure firewall (UFW/iptables) and set strong password policies and permissions.

12. Simulate a breach scenario (e.g. malware infection), collect logs and artifacts from "/var/log", ps, netstat. Analyze evidence and perform a proper digital forensic and incidence response.

| **Course Title:** Social Awareness and Civic Responsibility | |
|---|---|
| **Course Code:** FYCS-IKS205 | **Nature of Course: Indian Knowledge System** |
| **Credit: 2** | **Classes Per Week: L: 2 T: 0 P: 0** |

**Course Objectives:**

1. To instill civic sense, constitutional values, and a sense of social responsibility among students.
2. To enhance awareness of societal issues and the role of individuals in building a just, inclusive, and sustainable society.
3. To motivate students to engage in community service and participatory citizenship.
4. To enable students to critically evaluate the impact of policies and technologies on society.

**Course Outcomes (COs):**

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

CO-1: Understand key societal structures, issues, and challenges in India.
CO-2: Interpret the constitutional framework of rights, duties, and civic responsibilities.
CO-3: Apply ethical and civic values in real-life situations and community engagements.
CO-4: Contribute meaningfully to social causes through participatory practices.
CO-5: Evaluate and support policies that promote inclusiveness and sustainability.

## Syllabus

**Module I: Social Issues in India (8L)**

Overview of socio-economic challenges: Poverty, unemployment, and governance gaps. Discrimination based on caste, gender, religion, and sexuality. Child labour and child rights. Violence against women: causes, impact, and responses. Drug abuse: causes, prevention, and rehabilitation programs.

**Module II: Civic Engagement & Human Rights (8L)**

Role of youth in participatory governance and democratic change. Introduction to human rights: scope, protection, and global framework. Social movements in India: e.g., RTI, Nirbhaya, Anti-corruption. Role of NGOs, civil society organizations, and local self-governance bodies. Grassroots leadership and citizen-led reforms.

**Module III: Constitutional Values and Democratic Citizenship (7L)**

Constitutional principles: Preamble, Fundamental Rights, Duties, and DPSPs. Importance of civic responsibility and electoral participation. RTI, Lokpal, and other accountability frameworks. Role of digital citizenship, privacy, and responsible social media use.

**Module IV: Inclusive and Sustainable Development (7L)**

Empowerment of SC/ST, minorities, women, and differently-abled persons. Gender sensitization in society and institutions. Environmental awareness and civic responsibility. SDGs and youth-driven climate action.

**Textbook:**

1. **Indian Society: Structure and change** by Nadeem Hasnain *Publisher:* McGraw Hill Education

**Reference Books:**

1. **Introduction to the Constitution of India** by D.D. Basu *Publisher:* LexisNexis
2. **Social Problems in India** by Ram Ahuja *Publisher:* Rawat Publications
3. **Youth and Civic Engagement in India** by Dev Nath Pathak by *Publisher:* Sage Publications
4. **Human Rights in India: Historical, Social and Political Perspectives** by Chiranjivi J. Nirmal *Publisher:* Oxford University Press

| **Course Title:** Universal Human Values | |
|---|---|
| **Course Code:** FYCS-VAC206 | **Nature of Course: Value Added Courses** |
| **Credit: 2** | **Classes Per Week: L: 2 T: 0 P: 0** |

**Course Overview:**

The "Understanding India" course aims to provide students with a comprehensive understanding of India's multifaceted nature, encompassing its historical, social, cultural, and political landscapes. Through this course, students are expected to develop a deep appreciation for India's diversity, its rich heritage, and its contemporary challenges.

Students will gain knowledge about India's rich history, including its freedom struggle, the evolution of its culture, and the contributions of various communities and individuals.

The course will delve into India's social structure, exploring concepts like caste, community, and gender, and examining the dynamics of social change. Students will learn about the Indian political system, its constitutional framework, and the functioning of its institutions.

**Course Outcomes:**

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

CO-1: The course aims at making the students understand India from global, national and local perspectives

CO-2: A student would be able to understand India in geographical, historical, social, cultural and political settings

CO-3: At the end of the semester, the students will be able to appreciate the multicultural and multifaceted nature of India.

## Syllabus

**Module 1** **15L**

Bharatavarsha: concept and its evolution: Vedic, Epic and Puranic traditions and the making of Modern India. State and Imperial formation: Rise of Janapadas, The Mauryas, the Kushanas, the Guptas, Pallava, Cholas and Vijayanagara empire. Origin and growth of major religious streams: Vedic, Jainism, Buddhism, Bhakti and Sufism, Brahmo Samaj, Arya Samaj, Religious philosophy of Sri Aurobindo. Development of literary traditions: Panini, Kalidasa. Veda Vyasa, Valmiki, India's contribution to the world: Medical science: Charaka, Sushruta; Mathematics and Astronomy: Aryabhatta, Baudhyana, Brahmagupta, Ramanujam, Physics: Kanad, P.C. Ray, Raman

**Module II** **15L**

India's Struggle for freedom: 1857 as the First War of Independence. Important heroes of Freedom struggle: Birsa Munda, Bhagat Singh, Chandrasekhar Azad Subhash Chandra Bose. Formation of India National Congress and Contribution of Mahatama Gandhi;Making of

Indian constitution and its salient featurcs. Re-emergence of Swadeshi Movement in India; Flagship Programmes: Jan Dhan Yojana; Skill India Mission; Make in India; Atam Nirbhar Bharat.

**Suggested Readings**

1. Dhingra, I.C (2020).: Indian Economy, Sultan Chand & sons, New Delhi.
2. Dutt, R. and Sundharam (2018): Indian Economy, S. Chand & Co. Ltd., New Delhi.
3. Gautam A (2009): Advanced Geography of India, Sharda Pustak Bhawan, Allahabad.
4. Godschalk, D.R. (et.al.) (1999): Natural Hazard Mitigation Recasting Disaster Policy and Planning, Island Press, Washington, D.C.
5. Gore, M. S. (2002) Unity in Diversity: The Indian Experience in Nation-Building, Rawat Publication, Jaipur.
6. Government of India, Economic Survey (Annual), Economic Division, Ministry of Finance, New
7. Delhi. K. Roy, C. Saunders and J. Kincaid (2006) (eds.) 'A Global Dialogue on Federalism', Volume 3Montreal, Queen's University Press.
8. Kabir, Humayun (1946). Our Heritage, National Information and Publications Ltd., Mumbai.
9. L. Rudolph and S. Rudolph, (2008) 'Explaining Indian Institutions: A Fifty Year Perspective. 1956-2006', Volume 2, New Delhi, Oxford University Press.

| **Course Title:** Mathematics | |
|---|---|
| **Course Code:** MDC-1 | **Nature of Course: Multidisciplinary Course** |
| **Credit: 3** | **Classes Per Week: L: 3 T: 0 P: 0** |

**Course Objectives:**

1. To familiarize students with the basic concepts of differential and integral calculus.
2. To understand the application of series expansions and partial derivatives.
3. To develop a working knowledge of vector calculus operations such as gradient, divergence, and curl.
4. To learn the foundational aspects of coordinate geometry in two dimensions and apply calculus-based techniques to geometric problems.
5. To build a strong foundation in real analysis, focusing on sequences, limits, and continuity.

**Course Outcomes:**

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

CO-1: Apply differential calculus to analyze the behavior of functions, including Taylor and Maclaurin expansions.

CO-2: Evaluate definite and double integrals and apply them to areas and volumes.

CO-3: Understand and compute vector derivatives including grad, div, and curl, and interpret their physical significance.

CO-4: Transform coordinate systems and analyze conic sections through calculus techniques.

CO-5: Grasp fundamental real analysis concepts such as sequence convergence, limits, and continuity theorems.

## Syllabus

**Module 1: Differential Calculus** **9L**

Partial Differentiation and Euler's Theorem. Successive Differentiation, formulae for the nth derivative of some standard functions. Leibnits' theorem. Nth for the nth derivative of some rational function. Expansions of functions. Taylor's infinite series.Maclaurin's series.Use of Taylor's and Maclaurin's series.Tangents and Normals, their equations in Cartesian form, parametric forms. Tangents at the origin. To find the angles of intersection between two curves. Cartesian tangent, normal sub tangent, subnormal and their values in the Cartesian forms.

**Module 2: Integral Calculus** **9L**

Quick revision of +2 CBSE level +2 indefinite and definite integrals. Some illustrations of double integrals are possible via repeated integrals over regular domains. Rule for change of variables (without proof).

**Module 3: Vectors Calculus** **9L**

Vector point function of a scalar variable and its Differentiation. Directional derivative of scalar variable and its Differentiation. Directional derivative of scalar and vector point function, grad, div f and curt f: definition, formulation in terms of components, geometrical and physical meaning. Their action on sum and product.

**Module 4: Coordinate geometry of two dimensions** **9L**

Change of Coordinates under parallel translation of axes & rotation of axes about origin. Standard forms are the change of coordinates & props of parabolas, ellipses, and hyperbolas. On transformation of second degree equations in x and y: invariants, conditions for this to represent parabola, ellipse and hyperbola. Equation of tangent and normal using calculus.

**Module 5: Real analysis** **9L**

Axiomatic description of real no. System 'R', deduction of some usual facts about addition, multiplication, and order relation, including Archimedean property and relational density theorem. Notion of neighbourhood, bounds, closed sets and open sets together with their usual properties. Sequence and limit, uniqueness of limit, lim $(a_n+b_n)$, lim $(a_n.b_n)$, sandwich theorem, Cauchy's first Theorem on limit, monotonic sequences and their convergence, Nested interval theorem, Bolzano-Weierstrass theorem, Theorem on decimal form model of real number**.**

**Textbooks:**

1. M.D. Raisinghania – *Advanced Differential Calculus*, S. Chand
2. Shanti Narayan and P.K. Mittal – *Integral Calculus*, S. Chand
3. Murray R. Spiegel – *Vector Analysis (Schaum's Outline)*, McGraw-Hill
4. P.K. Jain and Khalil Ahmad – *Analytical Geometry of Two Dimensions*, New Age International
5. R.G. Bartle and D.R. Sherbert – *Introduction to Real Analysis*, Wiley

**Reference Books:**

1. Thomas and Finney – *Calculus and Analytical Geometry*, Pearson
2. George B. Thomas, Maurice D. Weir, Joel Hass – *Thomas' Calculus*, Pearson
3. S.C. Malik and Savita Arora – *Mathematical Analysis*, New Age International
4. Erwin Kreyszig – *Advanced Engineering Mathematics*, Wiley
5. Satya Prakash – *Vector Calculus*, Pragati Prakashan

| **Course Title:** Mathematical foundations of Probability and Statistics | |
|---|---|
| **Course Code:** MDC-2 | **Nature of Course: Multidisciplinary Course** |
| **Credit: 3** | **Classes Per Week: L: 3 T: 0 P: 0** |

**Course objectives:**

1. To study the basics of statistics, measure central tendency and dispersion.
2. Develop statistical methods for correlation, regression analysis and curve fitting.
3. Explore the principles of probability.
4. Understand the principles of probability distribution.
5. Explain the sampling theory, errors and chi distribution.

**Course outcomes-**

At the end of the course, the student will be able to :

CO-1: Elucidate the basic principles of statistics

CO-2: Apply the correlation and regression analysis to engineering problem

CO-3: Apply the principles of probability to thermodynamic problems

CO-4: Explain probability distribution and solve problems

CO-5: Explain the sampling, error and its applications

## Syllabus

**Module-1 Basic Statistics: 9L**

Measures of central tendency, measures of dispersion, range quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis, problems.

**Module-2 Statistical Methods: 9L**

Correlation and regression Karl Pearson's coefficient of correlation and rank correlation problems, regression analysis-lines of regression, problems. Curve fitting: curve fitting by the method of least square-fitting the curves of the form Y=ax+b, y=abx, y=ax2+bx+c.

**Module-3 Probability: 9L**

Introduction, sample space and events, Axioms of probability, Addition and multiplication theorems, conditional probability, Bayes' Theorem, problems.

**Module-4 Probability Distributions: 9L**

Random variables (discrete and continuous), probability mass/density function, Binomial, Poisson, Exponential and normal distributions problems (no derivations for mean and standard deviation)

**Module-5 Sampling theory: 9L**

Introduction to sampling distributions, standard error, type-I and type-II errors. Test of hypothesis of means, students' distribution, Chi-square distribution as a test of goodness of fit problems.

**Text Books:**

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Mathematical Statistics, 4thEdition (Reprint), Sultan Chand &Sons.

**Reference Books**:

1. Miller, Irwin and Miller, Marylees(2006): John E.Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
2. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co.Ltd.
3. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency.

| **Course Title:** Discrete Mathematics | |
|---|---|
| **Course Code:** MDC-3 | **Nature of Course: Multidisciplinary Course** |
| **Credit: 3** | **Classes Per Week: L: 3 T: 0 P: 0** |

**Course Objectives:**

1. To develop the fundamental ability to apply logical reasoning and algebraic structures in computing.
2. To understand key concepts in graph theory, set theory, combinatorics, and recurrence relations.
3. To apply matrix operations and number theory concepts to real-world problems and computer algorithms.
4. To build a foundation in abstract algebra and discrete structures relevant for data structures, cryptography, and algorithms.
5. To prepare students for advanced topics in data science, computer science, and artificial intelligence.

**Course Outcomes (COs):**

Upon completion of this course, students will be able to:

CO-1: Analyze logical statements, propositions, and Boolean expressions using truth tables and logical equivalences.
CO-2: Apply graph-theoretic principles and tree structures to design and solve computational problems.
CO-3: Demonstrate understanding of mappings, permutations, combinations, and counting techniques.
CO-4: Solve systems of linear equations using matrix theory and perform rank/echelon-based operations.
CO-5: Analyze number-theoretic concepts like divisibility, modular arithmetic, and recurrence relations.
CO-6: Understand abstract algebraic structures like groups, rings, and their application in cryptography and computation**.**

## Syllabus

**Module-I** **8L**

**Algebra of statements/Proposition**: Statement, Logical operations- negation, or, and, connectives- implication, bi-implication, Truth Table, Logical Equivalence, Tautology, contradiction; Algebraic relations: Quantifiers - (forever) and (three exists); Negation of qualified statements

**Boolean Algebra:** Definition and examples; properties, principle of duality, Boolean Functions, Normal forms and complements. Switching circuits.

**Module-II** **8L**

**Graph Theory:** Graph, hand staking lemma, Adjancy Matrix and Incidence Matrix; Walk Trail, Path & cycle. Simple graphs, connectedness, bi-partite graphs, weighted graph and Dijkastra Algorithm, seven bridge problem and Enlersion graphs.

**Tree:** properties, spanning trees kruskal's Algorithm for optimal spanning tree in a weighted connected graph; depth first search and Breadth first search, Binary tree, Binary search Tree, conversion of general tree to binary tree, preorder, In-order and post order transversal of a binary tree.

**Module-III** **8L**

Mapping and special types (injective, surjective and bijective), product of two maps and inverse of amc

Exclusion - Inclusion Principle, - General Counting Principle, counting various permutation and combination including order of a power set, injective, surjective and bijective maps and no. of solutions of x1, + x2 +…..+ xk = m in non-negative integers.

**Module-IV** **8L**

Matrices, special types, Transposition, Addition, multiplication and multiplication by Scalar. Behavior or laws of operations; inverse of square matrix, Elementary Matrices, echelon / quasi echelon reduction, rank, system of linear equation and structure of solution set. (Emphasis Should be on application of rules, not on vigorous proofs).

**Module-V** **8L**

Recurring sequence and series; recurrence relation, sum of recurring series in the interval of conveyance, nth terms by numerical calculus of linear difference equation, sum of n terms of a recurring series.

Fundamental Theorem of Arithmetic, induction on finitude of primes, divisibility L.C.M and G.C.D, remainders and consequence, Residue classes and Residue systems; Fermat's little theorem, $\phi(w)$ and Euler's generalization, solving algebraic consequences including theory for ax = b(modem)

**Module-VI** **8L**

Equivalence relation and partition; semigroup, group, subgroup and related Langrange's theorem. Abelianners, cyclic group permutation group, normal subgroup and quotieus group. Homomorplissun, Isamorphism and Automorphis and related results through examples (Illustration bases approach is desirable).

**Textbooks (Main Texts)**

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 7th Edition, McGraw-Hill Education

2. C.L. Liu and D.P. Mohapatra, Elements of Discrete Mathematics, 4th Edition, McGraw-Hill Education

3. Tremblay, J.P., and Manohar, R., Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill

**Reference Books**

1. Seymour Lipschutz and Marc Lipson, Schaum's Outline of Discrete Mathematics, 3rd Edition, McGraw-Hill
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall
3. Kolman, Busby, and Ross, Discrete Mathematical Structures, Pearson Education
4. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education

| **Course Title:** Statical Methods for Data Science | |
|---|---|
| **Course Code:** MDC-4 | **Nature of Course: Multidisciplinary Course** |
| **Credit: 3** | **Classes Per Week: L: 3 T: 0 P: 0** |

**Course Objectives:**

1. To introduce the fundamental concepts and scope of statistics relevant to data science.
2. To develop the ability to summarize and describe data using appropriate statistical tools.
3. To enable understanding of probability concepts and distributions for data modeling.
4. To equip students with the skills to conduct hypothesis testing and interpret outcomes.
5. To teach regression and correlation techniques to analyze relationships between variables.
6. To encourage statistical thinking in solving real-world data analysis problems

**Course Outcomes (COs):**

CO-1: Understand basic statistical terms, measures of central tendency, and variability.
CO-2: Apply probability theory to model uncertainty in data.
CO-3: Perform hypothesis testing and construct confidence intervals.
CO-4: Analyze relationships between variables using correlation and regression methods.
CO-5: Interpret and communicate statistical findings in data-driven scenarios.

## Syllabus

**Unit 1: Introduction to Statistics and Data Types** **9L**

Definition and scope of statistics; data types (quantitative, qualitative); population vs sample; frequency distributions; graphical representation of data using bar graphs, histograms, pie charts, and box plots.

**Unit 2: Descriptive Statistics** **9L**

Measures of central tendency (mean, median, mode); measures of dispersion (range, variance, standard deviation, coefficient of variation); skewness and kurtosis; use of MS Excel or Python for summary statistics.

**Unit 3: Probability Theory and Distributions** **9L**

Concepts of probability, conditional probability, and Bayes' Theorem; random variables; discrete and continuous probability distributions; Binomial, Poisson, and Normal distributions and their applications in data analysis.

**Unit 4: Inferential Statistics** **9L**

Concept of sampling and sampling distribution; central limit theorem; point and interval

estimation; hypothesis testing (z-test, t-test, chi-square test); p-value and level of significance; Type I and II errors.

**Unit 5: Correlation and Regression** **9L**

Types of correlation; Karl Pearson's correlation coefficient; Spearman's rank correlation; Simple linear regression model; interpretation of slope and intercept; use of regression in prediction and trend analysis.

**Text and References Books:**

1. Fundamentals of Statistics, Volume I & II – Goon, Gupta & Dasgupta.
2. Fundamentals of Statistics – S.C. Gupta.
3. Introduction to Probability and Statistics for Engineers and Scientists – Sheldon M. Ross.
4. Applied Statistics and Probability for Engineers – Douglas C. Montgomery & George. C. Runger.
5. Think Stats: Probability and Statistics for Programmers – Allen B. Downey.
6. Foundations of Data Science – Rajaraman & Aggarwal.

| **Course Title: English Communication and Professional Communication Skills** | |
|---|---|
| **Course Code:** FYCS – AEC207 | **Nature of Course: Ability Enhancement Course** |
| **Credit: 2** | **Classes Per Week: L: 2 T: 0 P: 0** |

**Course Objective**

1. To develop fundamental understanding of communication processes and principles.
2. To enhance reading and writing skills for academic and professional purposes.
3. To improve speaking and listening abilities in various communication contexts.
4. To build professional communication skills required in workplace environments.
5. To equip students with effective use of digital communication tools and etiquette.

**Course Outcomes:**

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

**CO1:** Understand and apply basic concepts of communication and grammar.
**CO2:** Demonstrate effective reading and writing skills for academic and professional communication.
**CO3:** Exhibit confidence in speaking, presentations, and interpersonal communication.
**CO4:** Apply professional communication skills such as resume writing, interviews, and workplace interactions.
**CO5:** Use digital communication tools effectively while following professional and ethical standards.

**Syllabus**

**Module I** **(15 Hours)**

Foundations of Communication:
Definition and process of communication, Types of communication (verbal and non-verbal), Barriers to communication and strategies to overcome (7 C's), Importance of listening and feedback, Basics of English grammar
Reading and Writing Skills:
Reading comprehension: Skimming, scanning, intensive and extensive reading, Paragraph writing, Note-making and summarizing, Formal and informal letter writing, Email writing and professional correspondence

**Module II** **(15 Hours)**

Speaking and Listening Skills:
Listening for gist and specific information, Public speaking, presentations and extempore, Telephonic communication and virtual meeting etiquette, Interview skills

Professional & Digital Communication:
Resume/CV and cover letter writing, Group discussions and mock interviews, Workplace communication (memos, notices, meeting minutes), Communication tools: Email, video conferencing, social media ethics

**Textbooks**

1. Raman, M., & Sharma, S. (2018). Technical Communication: Principles and Practice. Oxford University Press.
2. Rizvi, M. A. (2017). Effective Technical Communication. McGraw Hill Education.
3. Murphy, R. (2019). English Grammar in Use. Cambridge University Press.

**Reference Books**

1. Pease, A., & Pease, B. (2017). The Definitive Book of Body Language. Orion Publishing.
2. Carnegie, D. (2016). The Art of Public Speaking. Simon & Schuster.
3. Lesikar, R. V., & Flatley, M. E. (2015). Basic Business Communication. McGraw Hill.
4. Bovee, C. L., & Thill, J. V. (2018). Business Communication Today. Pearson.