

Draft Model Curriculum for UG Degree in
Bachelor in Computer Applications
BCA/BCA(Honours)/BCA(Honours with Research)

BCA
(For Batch 2026-2030)



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GENERAL COURSE STRUCTURE & CREDIT DISTRIBUTION

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
CC	Core Courses
AEC	Ability Enhancement Courses
MDE	Multi-Disciplinary Elective course
VAC	Value added Courses
SEC	Skill Enhancement courses
DSE	Discipline Specific Elective
OE	Open Elective

Course Name: Bachelor in Computer Application, Bachelor in Computer Application (Honours) and Bachelor in Computer Application (Honours with Research)

Course Level/Duration/System:

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:

- One year:** Under Graduate Certificate in Computer Application
- Two years:** Under Graduate Diploma in Computer Application
- Three years:** Bachelor in Computer Application (BCA)
- Four years:** Bachelor in Computer Application with Honours: BCA (Honours) or Bachelor in Computer Application 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:

- BCA (Honours with Research):** BCA Degree
- For 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)] PROGRAM:

Semester	Core Courses	Ability Enhancement Courses	Multi-Disciplinary Elective course	Value added Courses	Skill Enhancement courses	Discipline Specific Elective	Total
I	8	2	2	2	5	-	19
II	12	-	-	2	7	-	21
III	11	0	0	2	4	3	20
IV	15	0	0	0	2	3	20
V	0	0	0	0	6	15	21
VI	4	1	0	0	4	10	19
BCA (Honours)							
VII	5	0	3	0	4	8	20
VIII					8	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 course	Value added Courses	Skill Enhancement courses	Discipline Specific Elective	Total
BCA	50	3	2	6	28	31	120
BCA (Honours)	55	3	5	6	40	51	160
BCA (Honours with Research)	82	3	2	6	28	39	160

3 Years BCA Program	Total Credits = 120
4 Years BCA (Honours) and BCA (Honours with Research)	Total Credits = 160

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

INDUCTION PROGRAM

The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal, (Link:<https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf>). For more, Refer

Appendix III.

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

Mandatory Visits/ Workshop/Expert Lectures:

1. It is mandatory to arrange one industrial visit every semester for the students of each branch.
2. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

For Summer Internship / Projects / Seminar etc.

1. Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Note: The internal assessment is based on the student's performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.

Mapping of Marks to Grades

Each course (Theory/Practical) is to be assigned 100 marks, irrespective of the number of credits, and the mapping of marks to grades may be done as per the following table:

Range of Marks	Assigned Grade
91-100	AA/A ⁺
81-90	AB/A
71-80	BB/B ⁺
61-70	BC/B
51-60	CC/C ⁺
46-50	CD/C
40-45	DD/D
< 40	FF/F (Fail due to less marks)
-	F ^R (Fail due to shortage of attendance and therefore, to repeat the course)

Semester wise Structure and Curriculum for UG Course in BCA**SEMESTER I**

S. No.	Course Code	Course Title	L	T	P	Credit
3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)						
1	CC101	Mathematics Foundations to Computer Science - I	3	0	0	3
2	SEC101	Problem Solving Techniques	3	0	4	5
3	CC102	Computer Architecture	3	0	4	5
4	AEC101	General English - I	1	1	0	2
5	MDE101	Indian Knowledge System^	2	0	0	2
6	VAC101	Environmental Science and sustainability	2	0	0	2
7	AEC102	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1-0)) [optional course]*	1	1	0	0*
TOTAL						19

Note: ^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

Foreign Languages: (not limited to) Spanish/German/French/Korean/Mandarin etc.

SEMESTER II

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC103	Mathematics Foundations to Computer Science - II	3	0	0	3
2	CC104	Data Structures	3	0	4	5
3	CC105	Operating Systems	3	0	2	4
4	SEC102	Object Oriented Programming using Java	3	0	4	5
5	SEC103	Web Technologies	1	0	2	2
6	VAC102	Indian Constitution	2	0	0	2
7	AEC103	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1-0)) [optional course]*	1	1	0	0*
TOTAL						21

*Indian Languages: Sanskrit/Hindi/All Regional languages

Foreign Languages: (not limited to) Spanish/German/French/Korean/Mandarin etc.

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

An UNDER GRADUATE CERTIFICATE IN COMPUTER APPLICATION 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 Application (BCA) program after successfully completing the first year. Upon exit, they will be awarded a **UG Certificate in Computer Application**. To be eligible for this certificate, students must complete an additional 04 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 08 weeks, which will take place after the second semester.
4. **Social Responsibility & Community Engagement:** Active engagement with an NGO or community organization for a minimum duration of 08 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 respective **University/Admitting Body**, 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 in to Second Year (Third Semester) _

The student who takes an exit after one year with an award of certificate may be allowed to re-enter in to Third Semester for completion of the BCA Program as per the respective University /Admitting Body schedule after earning requisite credits in the First year.

Students can choose their specialization i.e. Stream with Discipline Specific Elective [DSE] from Second year onwards as indicated in Appendix -I

SEMESTER III

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC201	Probability and Statistics	3	0	0	3
2	CC202	Data Base Management System	3	0	4	5
3	SEC201	Python Programming	2	0	4	4
4	CC203	Software Engineering	3	0	0	3
5	DSE201*	Professional Elective – I	1	0	4	3
6	VAC201	Yoga/Sports/NCC/NSS/Disaster Management	0	0	4	2
TOTAL						20

* To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science / Artificial Intelligence and Machine Learning / Full Stack Development proposed by Universities as indicated at the appendix - A

SEMESTER IV

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC204	Entrepreneurship and Startup Ecosystem	1	1	0	2
2	CC205	Computer Networks	3	0	4	5
3	CC206	Design and Analysis of Algorithm	3	0	0	3
4	CC207	Artificial Intelligence	3	0	4	5
5	DSE202*	Professional Elective – II	1	0	4	3
6	SEC202	Design Thinking and Innovation	1	1	0	2
TOTAL						20

Note:

1. At the end of the Fourth Semester every student shall undergo Summer Training / Internship / Capstone for Eight Weeks in the industry/Research or Academic Institute. This component will be evaluated during the fifth semester.
2. An **UNDER GRADUATE DIPLOMA IN COMPUTER APPLICATION** will be awarded, if a student wishes to exit at the end of Second year.

Exit Criteria after Second Year of BCA Programme

Students will have the option to exit the Bachelor of Computer Application (BCA) program after successfully completing the second year. Upon exit, they will be awarded a **UG Diploma in Computer Application**. To be eligible for this diploma, students must complete an additional 04 credits in one of the following areas:

1. **Skill-Based Subject:** A specialized course aimed at enhancing technical and practical expertise in computer applications.
2. **Work-Based Vocational Course:** A vocational course offered during the summer term, focused on building practical, industry-relevant skills.
3. **Internship/Apprenticeship:** A professional internship or apprenticeship with a minimum duration of 08 weeks, conducted after the fourth semester, offering hands-on experience in a relevant field.
4. **Social Responsibility & Community Engagement:** Involvement with an NGO or community-based organization for a minimum of 08 weeks, contributing to social initiatives and applying computer application knowledge to solve real-world challenges.
5. **Capstone Project:** Completion of a capstone project integrating the skills and knowledge gained during the first two years of the program, which can be an independent or group project.

The specific mode of completing the additional credits will be decided by the respective **University/Admitting Body**, and students will be required to complete the 08-week program or project during the summer term following their fourth semester.

Students opting for this exit will also be required to **submit an Internship/Apprenticeship Report** or complete the Capstone Project as per the schedule outlined by the University/Admitting Body before they are awarded the UG Diploma.

Re-entry Criteria in to Third Year (Fifth Semester)

The student who takes an exit after second year with an award of Diploma may be allowed to re-enter into fifth Semester for completion of the BCA Program as per the respective University / Admitting Body schedule after earning requisite credits in the Second year.

SEMESTER V

S. No.	Course Code	Course Title	L	T	P	Credit
1	DSE301*	Professional Elective – III	3	0	4	5
2	DSE302*	Professional Elective – IV	3	0	4	5
3	DSE303*	Professional Elective – V	3	0	4	5
4	SEC301	Quantitative Techniques	0	2	0	2
5	SEC302	Internship/capstone Project	0	0	8	4
6	SEC303	Major Project [evaluation in sixth semester]	-	-	-	0
TOTAL						21

***L-T-P for Discipline Electives depends on the subject that the University offers**

SEMESTER VI

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC301	Generative AI	2	0	4	4
2	DSE304*	Professional Elective – VI	3	0	4	5
3	DSE305*	Professional Elective – VII	3	0	4	5
4	AEC301	Soft Skills	0	1	0	1
5	SEC304	Major Project [Initiated in 5th Semester]	0	0	8	4
TOTAL						19

***L-T-P for Discipline Electives depends on the subject that the University offers**

1. BACHELOR IN COMPUTER APPLICATION Degree will be awarded, if a student wishes to exit at the end of Third year.

[Exit Criteria after Third Year of BCA Programme](#)

The students shall have an option to exit after 3rd year of Computer Application Program and will be awarded with a Bachelor's in Computer Application.

[Re-entry Criteria in to Fourth Year \(Seventh Semester\)](#)

The student who takes an exit after third year with an award of BCA may be allowed to re-enter in to Seventh Semester for completion of the BCA (Honours) or BCA (Honours with Research) Program as per the respective University / Admitting Body schedule after earning requisite credits in the Third year.

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

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

SEMESTER VII - (BCA (Honours))
Specialization – AI & ML

S. No.	Course Code	Course Title	L	T	P	Credit
1	MDE401	Social Network Analysis	-	-	-	3
2	CC401	Optimization of ML	3	-	4	5
3	DSE401*	Professional Elective – VIII	3	-	4	5
4	DSE402*	Professional Elective – IX	-	-	-	3
5	SEC401	Dissertation work [evaluation in Eight semester]	-	-	-	-
6	SEC402	Summer Internship II	0	0	8	4
TOTAL						20

***L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University**

SEMESTER VII - (BCA (Honours))
Specialization – Data Science

S. No.	Course Code	Course Title	L	T	P	Credit
1	MDE401	Advanced Statistical methods for Data Science	-	-	-	3
2	CC401	Python for Data Science	3	-	4	5
3	DSE401*	Professional Elective – VIII	3	-	4	5
4	DSE402*	Professional Elective – IX	-	-	-	3
5	SEC401	Dissertation work [evaluation in Eight semester]	-	-	-	-
6	SEC402	Summer Internship II	0	0	8	4
TOTAL						20

***L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University**

SEMESTER VIII - (BCA (Honours))

S. No.	Course Code	Course Title	L	T	P	Credit
1	DSE403*	Professional Elective – X	3	-	4	5
2	DSE404*	Professional Elective – XI	3	-	4	5
3	DSE405*	Professional Elective – XII	2	-	-	2
4	SEC403	Dissertation work [Started in Seventh semester]	0	0	16	8
TOTAL						20

***L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University**

SEMESTER VII - (BCA – (Honours with Research))

S. No.	Course Code	Course Title	L	T	P	Credit
1	CC401	Advanced Data Analysis Tools	0	2	4	4
2	CC402	Research Methodology	2	2	0	4
3	CC403	Research Internship Report and Viva –Voce	0	0	8	4
4	DSEXX	Professional Elective – IX	-	-	-	4
5	DSEXX	Professional Elective – X	-	-	-	4
TOTAL						20

L-T-P w.r.t Open Elective and Discipline Specific Elective depends on the Courses offered by the University

SEMESTER VIII- (BCA –(Honours with Research))

S. No.	Course Code	Course Title	L	T	P	Credit
1	SEC401	Dissertation (For Research Track)*	-	-	-	20
TOTAL						20

*The Dissertation work will start from the beginning of fourth year of BCA (Honours with Research) Program.

Students of Fourth Year shall be assessed for Project Work and Research Internship Report and Viva –Voce and Dissertation (For Research Track).

Proposed Streams with Discipline-Specific Electives (DSE)

Note: The following is indicative. Universities/Institutes may add streams / electives as per their specific requirements.

1. Data Science

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Basics of Data Analytics using Spreadsheet
2	IV	DSE*202	Data Visualization
3	V	DSE301	Introduction to Data Science
4	V	DSE302	Time Series Analysis
5	V	DSE303	Machine Learning
6	VI	DSE304	Big Data Analytics
7	VI	DSE305	Exploratory Data Analysis
8	VII	DSE401	Business Intelligence & Analytics
9	VII	DSE402	Data Mining & Warehousing
10	VIII	DSE403	Advanced Data Visualization
11	VIII	DSE404	Cloud Computing for Data Analytics
12	VIII	DSE405	Data Security & Privacy

2. Artificial Intelligence & Machine Learning

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Feature Engineering
2	IV	DSE*202	Introduction to ML
3	V	DSE301	Neural Network
4	V	DSE302	Digital Image Processing
5	V	DSE303	Natural Language Processing
6	VI	DSE304	Deep Learning for Computer Vision
7	VI	DSE305	Predictive Analysis
8	VII	DSE401	Explainable AI
9	VII	DSE402	Evolutionary Algorithm
10	VIII	DSE403	Speech Recognition
11	VIII	DSE404	Augmented Reality & Virtual Reality
12	VIII	DSE405	Security aspects of ML

3. Full Stack Development

Sl.No	Semester	Course Code	Professional Elective
1	III	DSE*201	Web Programming -I
2	IV	DSE*202	Web Programming -II

SEMESTER –I

SEMESTER –I

Mathematics Foundation to Computer Science - I

CC101	Mathematics Foundation to Computer Science - I	3L:0T:0P	3 Credits
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Course Objectives

- CO1: Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics.
- CO2: This course enables the students to use mathematical models and techniques to analyze and understand problems in computer science.
- CO3: This course demonstrates how the mathematical principles give succinct abstraction of computer science problems and help them to efficiently analyze.

Course Content:

UNIT I: Set, Relation and Function:

Set, Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set, Closures of Relations, Warshall's algorithm.

Functions, properties of functions (domain, range), composition of functions, surjective (onto), injective (one-to-one) and bijective functions, inverse of functions.

Some useful functions for Computer Science: Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.

UNIT II: Counting and Recurrence Relation:

Basics of counting, Pigeonhole principle, permutation, combination, Binomial coefficients, Binomial theorem.

Recurrence relations, modelling recurrence relations with examples, like Fibonacci numbers, the tower of Hanoi problem. Solving linear recurrence relation with constant coefficients using characteristic equation roots method.

UNIT III: 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. Definitions and basic results on the topics mentioned.

UNIT IV: 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, applications of matrices to solve system of linear equations, Eigen values and Eigen vectors, Caley-Hamilton theorem.

Text Books

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, 2024. (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2023.

3. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
4. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India, 1979.
5. Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan, 2022.

Reference Books

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

Web Resources

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

Problem Solving Techniques

SEC101	Problem Solving Techniques	3L:0T:4P	5 Credits
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Course Objectives

- CO1: Understand basic terminology of computers, problem solving, programming Languages and their evolution (Understand)
- CO2: Create specification from problem requirements by asking questions to disambiguate the requirement statement. (Create)
- CO3: Design the solution from specification of a problem and write pseudo code of the algorithm using basic building blocks or structured programming constructs (Sequence, Selection and Repetition statement). (Create)
- CO4: Translate an algorithm into a C computer program (Create)
- CO5: Testing and analysing programs using debugging tools. (Analyze)

Prerequisite: This is an introductory programming course and hence no prerequisites

Course Content:

UNIT I: (CO-1, CO-2)

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, Efficiency, Correctness, Role of Data Structures in Problem Solving, Problem-Solving Steps (Understand the Problem, Plan, Execute, And Review), Breaking the Problem into Subproblems, Input/Output Specification, Input Validation, Pre and Post Conditions.

UNIT II: (CO-2, CO-3, CO-4)

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. Pseudocode and Flowcharts. Definition And Characteristics of Algorithms, Standard Algorithm Format. Problems Involving Iteration and Nesting: Displaying Different Patterns and Shapes Using Symbols and Numbers, Generating Arithmetic and Geometric Progression, Fibonacci and Other Sequences, Approximate Values For π , $\sin(x)$, $\cos(x)$, Etc. Using Taylor Series. Different Kinds of Data in The Real World and How They are Represented in The Computer Memory. Representation of Integers: Signed Magnitude Form, 1's Complement And 2's Complement. Representation of Real Numbers: IEEE 754 Floating Point Representation. Representation of Characters: ASCII, UNICODE.

C Language: Introduction To Programming Languages, Different Generations of Programming Languages. Typed Vs Typeless Programming Languages, History of C Language, An Empty C Program. C Language Counterparts For Input (scanf()), Output (printf()) Statements, Assignment, Arithmetic, Relational and Logical Operators. If, If-Else Statements, For, While, Do-While Statements. Data Types. Translating Pseudocode/Algorithm to C Program. Incremental Compilation and Testing of The C Program. Simple Problems Involving Input, Output, Assignment Statement, Selection and Repetition. Good Coding Practices.

UNIT III: (CO-2, CO-3, CO-4)

Problems on Numbers: Extracting Digits of a Number (Left to Right and Right to Left), Palindrome, Prime Number, Prime Factors, Amicable Number, Perfect Number, Armstrong Number, Factorial, Converting Number from One Base to Another. Statistics (Maximum, Minimum, Sum and Average) on a Sequence of Numbers which are Read using Sentinel-Controlled Repetition using only a few Variables.

C Language: else-if Ladder, switch Case, Increment/Decrement Operators, break and continue Statements.

UNIT IV: (CO-2, CO-3, CO-4, CO-5)

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. Sequential And Binary Search. Any one Sorting Algorithm. Matrix Operations.

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

Text Books

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

Reference Books

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

Problem Solving Techniques: Lab Problems

UNIT-II

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 ($n \geq 0$) 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 ($n > 0$) 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?

\$	\$	12345	12345
\$\$	\$\$	1234	1234
\$\$\$	\$\$\$	123	123
\$\$\$\$	\$\$\$\$	12	12
\$\$\$\$\$	\$\$\$\$\$	1	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
#####	1	* * * * *	*
# #	121	* * * *	***
# #	12321	* * *	*****
# #	1234321	* * *	***
#####	123454321	* * * * *	*

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 fibonacci sequence?
10. Display the first n ($n > 0$) terms of the Tribonacci sequence?
11. Given two positive integer numbers n_1 and n_2 check if the numbers are consecutive numbers of the fibonacci sequence?
12. Compute approximate value of π considering first n ($n > 0$) terms of the Taylor series for π ?
13. Compute approximate value of e^x considering first n ($n > 0$) terms of the Taylor series for e^x ?

14. Compute approximate value of $\sin(x)/\cos(x)$ considering first n ($n > 0$) terms of the Taylor series for $\sin(x)/\cos(x)$?

UNIT-III

1. Extract digits of an integer number (left to right and right to left)?
2. Given a sequence of digits form the number composed of the digits. Use sentinel controlled repetition to read the digits followed by -1. For example, for the input 2 7 3 2 9 -1 the output number is 27329?
3. Check if a given positive integer number is a palindrome or not?
4. Compute character grade from the marks ($0 \leq \text{marks} \leq 100$) of a subject. Grading Scheme: 80-100 : A, 60 - 79: B, 50 - 59: C, 40-49: D, 0-39: F? Solve this using both else-if ladder and switch case?
5. Compute the sum of a sequence of numbers entered using sentinel controlled repetition?
6. Check if a given positive integer number is a prime number or not?
7. Compute prime factors of a positive integer number?
8. Check if two positive integer numbers are amicable numbers or not?
9. Check if a given positive integer number is a perfect number or not?
10. Check if a given positive integer number Armstrong number or not?
11. Converting a positive integer number ($n > 0$) from one base (inputBase) to another base (outputBase) ($2 \leq \text{input Base}$, $\text{outputBase} \leq 10$). Input number should be validated before converting to make sure the number uses only digits allowed in the input base?
12. 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"?
13. Using the grading scheme described in the question 4 (UNIT III), Compute how many students awarded each grade and display the frequency as a bar chart (horizontal) using single "*" for each student. Use sentinel controlled repetition (-1 as sentinel value) in reading the students marks. Use else-if ladder/switch case to compute the grade and the corresponding frequency.

Sample bar chart when the class has 7-A, 10-B, 3-C, 7-D and 1-F grades.

A:

B:

C: ***

D:

F: *

14. Compute maximum, minimum, sum and average of a sequence of numbers which are read using sentinel controlled repetition using only few variables?
15. Compute body mass index, $\text{BMI} = \text{weightinKGs} / (\text{HeightinMeters} * \text{HeightinMeters})$, 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

UNIT IV

1. Design a modularized algorithm/program to check if a given positive integer number is a circular prime or not?
2. Design a modularized algorithm/program to compute a maximum of 8 numbers?
3. Design a modular algorithm/program which reads an array of n integer elements and outputs mean (average), range (max-min) and mode (most frequent elements)?
4. Design a modular algorithm/program which reads an array of n integer elements and outputs median?
5. Implement your own string length and string reversal functions?
6. Design algorithm/program to perform matrix operations addition, subtraction and transpose?
7. Write a recursive program to count the number of digits of a positive integer number?
8. 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)?
 - c. Compute x^y using only multiplication?
 - d. To print a sequence of numbers entered using sentinel controlled repetition in reverse order?

Computer Architecture

CC102	Computer Architecture	3L:0T:4P	5 Credits
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Course Objectives

- CO1: To Understand the basics of Digital Electronics and Binary Number System
 CO2: To Learn the implementation of Combinational Circuit.
 CO3: To Learn the implementation of Sequential Circuit.
 CO4: To Understand the Organization of basic computers.
 CO5: To Understand the concept of Parallel Processing.
 CO6: To understand the concept of memory organization.

Course Content:

UNIT-I

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, Error detecting and correcting codes, ASCII, EBCDIC, Excess-3 Code, The Gray Code.

UNIT-II

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.

Register: 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

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

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- “Digital Principles & Applications” , Tata McGraw Hill Education Private Limited,2011Edition.
2. M. Morris Mano- “Computer System Architecture”, Pearson/Phi, Third Edition.

Reference Books:

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

Suggestive Laboratory Experiments:

1. Verify logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates.
2. To study and verify NAND as a Universal Gate
3. To verify De- Morgan’s theorem for 2 variables
4. Design and test of an S-R flip-flop using NAND/NOR gate.
5. Convert BCD to Excess-3 code using NAND gate
6. To Convert Binary to Grey Code
7. Verification of Truth Tables of J-K Flip-Flop using NAND/NOR gate
8. Realize Decoder and Encoder circuit using Basic Gates.
9. Design and implement the 4:1 MUX using gates.
10. Implementation of 4-Bit Parallel Adder Using 7483 IC.
11. Design and verify operation of half adder and full adder.
12. Design and verify operation of half subtractor.
13. Design and Implement a 4 bit shift register using Flip flops.
14. Implement Boolean function using logic gates in both SOP and POS
15. Design and Implement a 4 bit synchronous counter.
16. Design and verify 4 bit asynchronous counter.

Hardware

1. Familiarize the computer system layout: marking positions of SMPS, motherboard, FDD, HDD, CD, DVD and add on cards.
2. Identify the Computer Name and Hardware Specification (RAM capacity, Processor type, HDD, 32 bit/ 64 bit)
3. Identify and Troubleshoot the problems of RAM, SMPS and motherboard
4. Configure BIOS settings- disable and enable USB and LAN
5. Adding additional RAM to the system.(expanding RAM size).
6. To Study mother board layout of a system.
7. Demonstrate the assembly of a PC
8. Demonstration of various ports: CPU, VGA port, PS/2 (keyboard, mouse) ,USB, LAN, Speaker, Audio.
9. Install and configure windows OS
10. To study the installation of Printer and trouble shooting.

General English – I

AEC 101	General English - I	1L:1T:0P	2 Credits
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Course Objective:

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.

Course Content:

Unit- I: 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.

Unit-II: 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- III: Identifying Common Errors in Writing

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies

Unit- IV: Nature and Style of sensible Writing

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Module V: Writing Practices, Comprehension, Précis Writing, Essay Writing

Unit-V: 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

Unit- VI: 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. AICTE's Prescribed Textbook: Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book Publishing Co., 2023.
2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011. 8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Alternative NPTEL/SWAYAM Course:

S.No.	NPTEL/SWAYAM Course Name	Instructor	Host Institute
1	English language for competitive exams	Prof. Aysha iqbal	IIT MADRAS
2	Technical English for engineers	Prof. Aysha iqbal	IITM

Course Outcomes: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills

Indian Knowledge System

MDE 101	Indian Knowledge System	2L:0T:0P	2 Credits
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*For Detailed Course Refer APPENDIX – II

Environmental Science and Sustainability

VAC 101	Environmental Science and Sustainability	2L:0T:0P	2 Credits
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Course description:

This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers. The course content is divided into four comprehensive units.

Unit 1 introduces basic environmental principles, the man-environment relationship, and sustainability issues.

Unit 2 focuses on ecosystems, biodiversity, and sustainable practices.

Unit 3 addresses environmental pollution, waste management, and sustainable development strategies. Finally,

Unit 4 explores social issues, environmental legislation, and practical applications through hands-on fieldwork. Through this holistic approach, students will gain a deep understanding of environmental processes, the importance of sustainable practices, and their role in promoting sustainability within business contexts.

Course Objective(s):

1. This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forthcoming sustainability challenges.
2. This course will equip students to make decisions that consider environmental consequences.
3. This course will enable future business graduates to become environmentally sensitive and responsible managers.

Course Content:

Unit 1: 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 2: 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 3: 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 4: 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.

Readings:

Text Books (Latest Editions):

- Poonia, M.P. *Environmental Studies* (3rd ed.), Khanna Book Publishing Co.
- Bharucha, E. *Textbook of Environmental Studies* (3rd ed.) Orient Blackswan Private Ltd.
- Dave, D., & Katewa, S. S. *Text Book of Environmental Studies*. Cengage Learning India Pvt Ltd.
- Rajagopalan, R. *Environmental studies: from crisis to cure* (4th ed.). Oxford University Press.
- Miller, G.T. & Spoolman S. *Living in the Environment*. (20th ed.). Cengage.
- Basu, M., & Xavier Savarimuthu, S. J. *Fundamentals of environmental studies*. Cambridge University Press.
- Roy, M. G. *Sustainable Development: Environment, Energy and Water Resources*. Ane Books.
- Pritwani, K. *Sustainability of business in the context of environmental management*. CRC Press.
- Wright, R.T. & Boorse, D.F. *Environmental Science: Toward A Sustainable Future* (13th ed.). Pearson.

References

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>

Course Outcome(s):

1. Explore the basic environmental concepts and issues relevant to the business and management field.
2. Recognize the interdependence between environmental processes and socio-economic dynamics.
3. Determine the role of business decisions, policies, and actions in minimizing environmental degradation.
4. Identify possible solutions to curb environmental problems caused by managerial actions.
5. Develop skills to address immediate environmental concerns through changes in business operations, policies, and decisions.

SEMESTER –II

SEMESTER –II

Mathematics Foundation to Computer Science - II

CC103	Mathematics Foundation to Computer Science - II	3L:0T:0P	3 Credits
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Course Objectives

- CO1: This course helps the students to understand correct lines of arguments and proofs.
- CO2: This course introduces mathematical techniques that are foundations for understanding advanced computational methods, including numerical methods and optimization.
- CO3: This course helps the students to understand various problem-solving strategies and methods to tackle both theoretical and practical challenges in computer science.

Course Content:

UNIT I:

Logic and Methods of Proofs:

Propositions, logical operations (basic connectives), compound statements, construction of truth table, quantifiers, conditional statements, tautology, contradiction, contingency, logical equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF).
Methods of proofs: Rules of inference for propositional logic, modus ponens, modus tollens, syllogism, proof by contradiction, Mathematical Induction.

UNIT II:

Algebraic Structures:

Semi-group, Monoid, Group, Subgroup, Cyclic group.

UNIT III:

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
Only formula and problem solving for all the topics mentioned above.

UNIT IV:

Optimization Techniques:

Linear programming: Introduction, LP formulation, Graphical method for solving LPs with two variables, Special cases in graphical methods, Simplex method, Duality.
Transportation problem: Definition, Linear form, North-west corner method, Least cost method, Vogel's approximation method for finding feasible solution, MODI method for finding optimum solution.

Text Books

1. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
2. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL, 2022.

3. Taha Hamdy A., Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall, 2003.
4. S.B. Singh, Discrete Structures, Khanna Book Publishing, 2023 (AICTE Recommended Textbook)

Reference Books

1. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India, 2019.
2. Chakravorty J. G. and Ghosh P. R., Linear Programming and Game Theory, Moulik Library, 2017.
3. Sharma J. K., Operations Research: Theory and Applications, Fourth Edition, Macmillan Publishers, 2007.

Web Resources

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

Data Structures

CC104	Data Structures	3L:0T:4P	5 Credits
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Course Objectives

- CO1: Understand the fundamental concepts of Data Structures and their applications.
CO2: Develop problem-solving skills using Data Structures.
CO3: Implement Data Structures using C programming language.

Prerequisite:

1. **Programming Fundamentals:** Understanding the basic syntax and semantics of C programming language.
2. **Problem-Solving Skills:** Ability to break down a problem into smaller steps and devise a step-by-step solution and familiarity with simple algorithms.

Course Content:

UNIT I:

Introduction and Overview: Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Tradeoff.

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, Multi-Dimensional Arrays.

UNIT II:

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:

Stacks: Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List, Application of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression.

Recursion: Definition, Recursive Notation, Runtime Stack, Applications of Recursion: Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi.

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:

Graphs: Definition, Terminology, Representation, Traversal.

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

Text Books

1. R.B. Patel, "Expert Data Structures with C", Khanna Book Publishing Company, 2023 (AICTE Recommended Textbook)
2. Seymour Lipschutz, "Data Structures with C", Schaum's Outlines, Tata McGraw-Hill, 2011.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications, 2022.

Reference Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2014.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press, 2007.

Web Resources

1. **GeeksforGeeks** - Data Structures Tutorial
2. **Khan Academy** - [Algorithms Course](#)

Lab Programs:

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

CC105	Operating Systems	3L:0T:2P	4 Credits
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Course Content:

UNIT I:

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:

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:

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:

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, Operating Systems Concepts, Khanna Publishing House, 2022 (AICTE Recommended Textbook)
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.
3. Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.

Reference Books:

1. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.

2. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

Course Outcomes (COs):

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

- 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.

Operating Systems LAB

List of experiments

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 Bankers 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.

Course Outcomes (COs):

- 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.

Object Oriented Programming using Java

SEC102	Object Oriented Programming using Java	3L:0T:4P	5 Credits
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Course Objectives

- 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

Prerequisite: Knowledge of Problem Solving Techniques using C programming language

Course Content:

UNIT I:

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 function, Application of two classes, Java Program Structure, Java Tokens and statements, Implementing Java program And JVM, Command Line Arguments.

Text Book 1: Chapters 1, 2 and 3.

UNIT II:

Constants, Variables and Data Types: Constants, Variables, Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Typecasting.

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, Labelled loops.

Text Book 1: Chapters 4, 5, 6, and 7.

UNIT III:

Classes, Objects and Methods: Defining Class, Methods Declaration, Constructors, Methods Overloading, Overriding Methods, 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.

Text Book 1: Chapters 8, 9, and 10.

UNIT IV:

Packages: Basics of packages, System packages, Creating and accessing packages, Creating

user defined packages, Adding 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 Book 1: Chapters 11 & 13.

Text Books

1. Balaguruswamy E. (2023). Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education
2. Schildt, H. (2022). Java: The Complete Reference. 12th edition. McGraw-Hill Education.

Reference Books

1. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited, 2012.
2. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited, 2015.
3. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson, 2008.
4. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press, 2014.

Web Resources

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

List of Practical:

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 commandline 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 superclass. 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 additional member 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

SEC103	Web Technologies	1L:0T:2P	2 Credits
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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

Prerequisite:

1. Proficiency in at least one programming language, such as Python, Java, or C++. Understanding of programming concepts such as loops, conditionals, functions, and data structures like arrays, lists.
2. Familiarity with object-oriented programming (OOP) principles, including classes, objects, inheritance, and polymorphism.

Course Content:

Unit I:

Introduction to HTML, history of HTML, Objective, 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.

Introduction to CSS, types, Selectors, and Responsiveness of a web page.

Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding the
Grid 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 II:

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.

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 & 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, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications, 2016
2. Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition, 2017

Reference Books

1. Silvio Moreto, Bootstrap 4 By Example, ebook, 2016.
2. Tanweer Alam, Web Technologies, Khanna Book Publishing, 2011.

Web Resources

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

Practical list of Programs:

PART-A

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, color 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.

PART – B

- 1) Write an HTML/JavaScript page to create login page with validations.
- 2) Develop a Simple calculator for addition, subtraction, multiplication and division operation using JavaScript.
- 3) Use Regular Expressions for validations in Login Page using JavaScript.
- 4) Write a Program to retrieve data from a text file and displaying it using AJAX.
- 5) Create XML file to store Student Information like Register Number, Name, Mobile Number, DOB, and Email-Id.
- 6) Create a DTD for (0).
- 7) Create XML scheme for (0).
- 8) Create XSL file to convert XML file to XHTML file.
- 9) Write a JavaScript program using Switch case.
- 10) Write a JavaScript program using any 5 events.
- 11) Write a JavaScript program using built in JavaScript objects.
- 12) Write program for populating values from JSON text.
- 13) Write a program to transform JSON text to a JavaScript object.

Indian Constitution

VAC102	Indian Constitution	2L:0T:0P	2 Credits
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Course Content:

Unit 1: 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 2: Union Government

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

Unit 3: State Government

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

Unit 4: Local Administration

- District Administration
- Municipal Corporation
- Zila Panchayat

Unit 5: Election Commission

- a. Role and Functioning
- b. Chief Election Commissioner
- c. State Election Commission

Suggested Learning Resources:

1. Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi, 2008
2. The Constitution of India by B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India by DD Basu Lexis Nexis; Twenty-Third, 2018 edition

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

Course Outcome(s):

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

1. Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure.
2. Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha).
3. State Government Mechanisms: Examine the powers of the Governor, Chief Minister, and the State Secretariat.
4. Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats.
5. Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections.
6. Application of Knowledge: Apply constitutional principles to contemporary political issues and evaluate governance effectiveness.

SEMESTER –III

SEMESTER –III

Probability and Statistics

CC201	Probability and Statistics	3L:0T:0P	3 Credits
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Course Objectives

CO1: This course aims to make the students trained to handle randomness scientifically using theory of probability.

CO2: This course intends to make the students able to represent the statistical data in a systematic way and analyze it to draw meaningful information from them.

CO3: Through plentiful examples and exercises, this course provides the students scope to apply probabilistic and statistical techniques to deal with the real-life problems.

Course Content:

UNIT I:

Basic concepts of Statistics, qualitative and quantitative data, classification of data, construction of frequency distribution, diagrammatic representation of data.

Measures of Central Tendency: Arithmetic mean, median and mode—their properties

Measures of Dispersion: Range, mean deviation, quartile deviation, variance and standard deviation.

UNIT II:

Correlation: Definition, scatter diagram, types of correlation, measures—Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient.

Regression: Linear regression-fitting by least square method and interpretation.

UNIT III:

Concepts of probability: Experiment and sample space, events and operations with events, probability of an event, basic probability rules, applications of probability rules, conditional probability.

Random Variables: Discrete and continuous random variable, probability distribution of a random variable, probability mass function, probability density function, expectation and variance of a random variable.

Standard Probability Distributions: Binomial probability distribution, Poisson probability distribution, Normal probability distribution.

UNIT IV:

Sampling Distribution: Concept of Population and Sample, parameter and statistic, sampling distribution of sample mean and sample proportion.

Statistical Inference: Estimation and Hypothesis Testing (only concept).

Hypothesis Testing for a Single Population: Concept of a hypothesis testing, tests involving a population mean and population proportion (z test and t test).

Chi square test for independence of attributes and goodness of fit.

Text Books

1. Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, 2010 (AICTE Recommended Textbook)
2. Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill, 2010.
3. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier, 2021.
4. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education, 2005

Reference Books

1. Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI, 2013
2. Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley, 2016.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, 2024.

Web Resources

1. <https://nptel.ac.in/courses/111106112>
2. <https://nptel.ac.in/courses/111105041>

Database Management Systems

CC202	Database Management Systems	3L:0T:4P	5 Credits
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Course Objectives

CO1: Understanding Core Concepts of DBMS

CO2: Proficiency in Database Design and SQL

CO3: Application of Advanced Database Techniques

Prerequisite: Basic knowledge of Set Theory.

Course Content:

UNIT I:

Introduction to Databases: Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators

Data Models: Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS

Database Design: Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in a table: Primary Key, Foreign Key,

Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema

UNIT II:

Relational Algebra and Calculus: Introduction to Relational Algebra, Operations: Selection, Projection, Set Operations, Join Operations, Division, Tuple and Domain Relational Calculus

Structured Query Language (SQL): SQL Basics: DDL and DML, Aggregate Functions (Min(), Max(), Sum(), Avg(), Count()), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses (Group By, Having, Order by, top/limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join

Advanced SQL: Analytical queries, Hierarchical queries, Recursive queries, Views, Cursors, Stored Procedures and Functions, Packages, Triggers, Dynamic SQL

Normalization and Database Design: Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization.

UNIT III:

Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery, 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlocks

Database Storage and Indexing: Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection

UNIT IV:

NoSQL Databases and Big Data: Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra.

Database Security and Advanced Topics: Introduction to Database Security, Access Control, Discretionary Access Control, Introduction to Data Warehousing, OLAP, Data Mining

Text Books

1. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill, 2018
2. Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall, 2015
3. Brad Dayley, "NoSQL with MongoDB in 24 Hours", 1st edition, Sams Publishing, 2024

Reference Books

1. Korth, Silbertz, Sudarshan, "Database System Concepts", Seventh Edition, McGraw - Hill. (2019)

2. R.P. Mahapatra, Govind Verma, “Database Management Systems”, Khanna Publishing House, 2025.

Web Resources

1. <https://oracle-base.com/articles>
2. https://forums.oracle.com/ords/apexds/domain/dev-community/category/sql_and_pl_sql
3. <https://asktom.oracle.com/ords/f?p=100:1:0>

List of Practicals:

1. Draw an ER Diagram of Registrar Office
2. Draw an ER Diagram of Hospital Management System
3. Reduce The ER diagram in question no 1 into tables
4. Reduce the ER diagram of question no 2 into tables

Consider the following Schema

Supplier(SID, Sname, branch, city, phone)

Part(PID, Pname, color, price)

Supplies(SID, PID, qty, date_supplied)

DDL Commands

5. Create the above tables
6. Add a new attribute state in supplier table
7. Remove attribute city from supplier table
8. Modify the data type of phone attribute
9. Change the name of attribute city to address
10. Change a table's name, supplier to sup
11. Use truncate to delete the contents of supplies table
12. Remove the part table from database

DML Commands

1. Insert at least 10 records in tables supplier, part and supplies
2. Show the contents in tables supplier, part and supplies
3. Find the name and city of all suppliers
4. Find the name and phoneno of all suppliers who stay in 'Delhi'
5. Find all distinct branches of suppliers
6. Delete the record of the supplier whose SID is 204001
7. Delete all records of supplier table
8. Delete all records of suppliers whose city starts with capital A.
9. Find the supplier names which have 'lk' in any position
10. Find the supplier name where 'R' is in the second position
11. Find the name of supplier whose name starts with 'V' and ends with 'A'
12. Change the city of all suppliers to 'BOMBAY'
13. Change the city of supplier 'Vandana' to 'Goa'

Queries with Constraints

1. Create the supplier table with Primary Key Constraint
2. Create supplies table with Foreign key Constraint
3. Create a part table with UNIQUE Constraint
4. Create supplier Table with Check Constraints
5. Create Supplier table with Default Constraint

Queries on TCL

1. Create Savepoints
2. Rollback to SavePoints
3. Use Commit to save on

Aggregate Functions:

1. Find the minimum, maximum, average and sum of costs of parts
2. Count the total number of parts present
3. Retrieve the average cost of all parts supplied by 'Mike'

Queries on GROUP BY, HAVING AND ORDER BY Clauses

1. Display total price of parts of each color
2. Find the branch and the number of suppliers in that branch for branches which have more than 2 suppliers
3. Find all parts sorted by pname in ascending order and cost in descending order
4. Find the branch and the number of suppliers in that branch

Queries on Analytical, Hierarchical, Recursive nature.

1. Find out the 5th highest earning employee details.
2. Which department has the highest number of employees with a salary above \$80,000, and what percentage of employees in that department have a salary above \$80,000
3. Retrieve employee table details using the hierarchy query and display that hierarchy path starting from the top level indicating if it is a leaf and there exists a cycle.
4. What is the average salary for employees in the top 2 departments with the highest average salary, and what is the hierarchy of departments and sub-departments for these top 2 departments?
5. Use recursion to retrieve the employee table and display the result in breadth first and depth first order.
6. Write a recursive query to show the equivalent of level, connect_by_root and connect_by_path
7. Use recursion to retrieve the employee table and display the result in depth first order showing id, parent_id, level, root_id, path and leaf.

Queries on Operators

1. Find the pname, phoneno and cost of parts which have cost equal to or greater than 200 and less than or equal to 600.
2. Find the sname, SID and branch of suppliers who are in 'local' branch or 'global' branch
3. Find the pname, phoneno and cost of parts for which cost is between 200 and 600

4. Find the pname and color of parts , which has the word 'NET' anywhere in its pname.
5. Find the PID and pname of parts with pname either 'NUT' or 'BOLT'
6. List the suppliers who supplied parts on '1st may2000', '12 JAN 2021' , '17 dec 2000' , '10 Jan 2021'
7. Find all the distinct costs of parts

Join Operators

1. Perform Inner join on two tables
2. Perform Natural Join on two tables
3. Perform Left Outer Join on tables
4. Perform Right Outer join on tables
5. Perform Full Outer Join on tables

Set Theory Operators

1. Show the use of UNION operator with union compatibility
2. Show the use of intersect operator with union compatibility
3. Show the use of minus operator with union compatibility
4. Find the cartesian product of two tables

Queries on Set Theory Operators

1. List all parts except 'NUT' and 'BOLT' in ascending order of costs
2. display all parts that have not been supplied so far
3. To display the supplier names who have supplied 'green' part with cost 500 Rupees AND 'red' part with cost 400 Rupees.
4. To display the supplier names who have supplied 'green' part with cost 500 Rupees OR 'red' part with cost 400 Rupees.
5. To Display the name of suppliers who have supplied all parts that are 'red' in color.

PL/SQL Programs

1. **Write a PL/SQL Code to add two numbers**
2. **Write a PL/SQL code for Fibonacci series**
3. **Write a PL/SQL Code for greatest of 3 numbers**
4. Write a PL/SQL code for area and circumference of a circle

PL/SQL Programs on Cursors

1. **Write a Program using CURSOR to display SID and city of 1st record of supplier**
2. Write a program using cursors to display the SID and City of all suppliers and then print the count of suppliers.

PL/SQL Programs on Triggers, Procedures and Functions

1. Write a Program using TRIGGER on UPDATE

2. Write a command to See the effect of trigger
3. Write a Program using PROCEDURE to increase the cost by Rs.1000 for part whose PID is passed as an argument.
4. Write a procedure to update the city of an supplier whose SID and city are passed as arguments and the procedure returns the name of supplier whose city is updated.
5. Write a function to return the total number of suppliers
6. Write a function to return the PID of part, for which the part name is passed
7. Write a function to find the sum total of costs of all parts.

PL/SQL Programs on Implicit Cursors

1. Insert a record using %ROWTYPE
2. Write a code using %NOTFOUND, %FOUND, %ROWCOUNT
3. Write a code using %TYPE

MongoDB Queries

1. Create a collection and insert documents into it using insertOne() and insertMany()
2. Select all documents in collection
3. Find the count of all suppliers
4. Find all records that have city = 'Delhi'
5. Retrieve all documents that have color equal to 'red' or 'green'
6. Retrieve all documents where part_name is 'P1' or price is less than 200.
7. Update the record of 'Geeta', set city = 'Bombay' and phoneno = '11223344'
8. Delete all records where price is greater than 5000
9. Display only the name and city of the supplier
10. Sort all suppliers on city and display only the first two records.

Python Programming

SEC201	Python Programming	2L:0T:4P	4 Credits
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Course Objectives:

CO1: Develop modular Python programs.

CO2: Apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem.

CO3: Understand basic Data visualization and File handling in Python.

Prerequisites:

Understanding of Problem solving techniques using a programming language and basic data structures.

Course Content:

UNIT I:

Introduction: History and Application areas of Python; Structure of Python Program; Identifiers and Keywords; Operators and Precedence; Basic Data Types and type conversion;

Statements and expressions; Input/Output statements.

Strings: Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining; Formatting Strings.

Control Flow Statements: Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, Pass and exit.

UNIT II:

Functions: Built-In Functions, Function Definition and call; Scope and Lifetime of Variables, Default Parameters, Command Line Arguments; Lambda Functions; Assert statement; Importing User defined module;

Mutable and Immutable objects: Lists, Tuples and Dictionaries; Commonly used Functions on Lists, Tuples and Dictionaries. Passing Lists, tuples and Dictionaries as arguments to functions. Using Math and Numpy module for list of integers and arrays.

UNIT III:

Files: Types of Files; Creating, Reading and writing on Text and Binary Files; The Pickle Module, Reading and Writing CSV Files. Reading and writing of csv and JSON files.

Exception Handling: Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions.

Data visualization: Plotting various 2D and 3D graphics; Histogram; Pie charts; Sine and cosine curves.

Text Books:

1. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021.
2. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023.
3. Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017.

Reference Books:

1. Think Python, by Allen Downey, 2nd edition, 2015, O'Reilly.
https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view
2. An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.
3. Introduction to Computation and Programming using Python, by John Guttag, 2nd edition, 2016, PHI India.

Web Resources:

1. <https://www.learnpython.org/>
2. <https://www.w3schools.com/python/default.asp>

Practical List:

1. Write a program to find whether a number is a prime number.
2. Write a program to print m raise to power n, where m and n are read from the user.
3. Write a program having a parameterised function that returns True or False depending on whether the parameter passed is even or odd.
4. Write a program to print the summation of the following series upto n terms: 1-2+3-4+5-6+7 - - - - -n
5. Write a menu driven program to perform the following operations on strings using string built in functions.
 - a. Find the frequency of a character in a string.

- b. Replace a character by another character in a string.
 - c. Remove the first occurrence of a character from a string.
 - d. Remove all occurrences of a character from a string.
6. Write a program that accepts two strings and returns the indices of all the occurrences of the second string in the first string as a list. If the second string is not present in the first string, then it should return -1
 7. Using Numpy module write menu driven program to do following
 - a. Create an array filled with 1's.
 - b. Find maximum and minimum values from an array
 - c. Dot product of 2 arrays.
 - d. Reshape a 1-D array to 2-D array.
 8. Write a function that takes a sentence as input from the user and calculates the frequency of each letter. Use a variable of dictionary type to maintain the count.
 9. Consider a tuple t1=(1,2,5,7,9,2,4,6,8,10). Write a program to perform following operations:
 - a. Print contents of t1 in 2 separate lines such that half values come on one line and other half in the next line.
 - b. Print all even values of t1 as another tuple t2.
 - c. Concatenate a tuple t2=(11,13,15) with t1.
 - d. Return maximum and minimum value from t1..
 10. Write a function that reads a file file1 and copies only alternative lines to another file file2. Alternative lines copied should be the odd numbered lines.
 11. Write a Python program to handle a ZeroDivisionError exception when dividing a number by zero.
 12. Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
 13. Write a program that makes use of a function to display sine, cosine, polynomial and exponential curves.
 14. Take as input in the months and profits made by a company ABC over a year. Represent this data using a line plot. Generated line plot must include X axis label name = Month Number and Y axis label name = Total profit.

Software Engineering

CC203	Software Engineering	3L:0T:4P	3 Credits
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Course Objectives

- CO1: To Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.
- CO2: To Develop proficiency in project management methodologies and strategic decision-making for successful software project execution.
- CO3: To Master the art of software design, development, and testing to produce robust and efficient software solutions.

Prerequisites: Basic understand of Software, Applications, Programming fundamentals.

Course Content:

UNIT I:

The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.

UNIT II:

Software Requirements Engineering: Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan.

Project planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.

UNIT III:

Design: Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

UNIT IV:

Quality Management: Quality concepts, software quality assurance, software reviews, formal

technical reviews, statistical software quality assurance, software reliability.

Release Management: Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring.

Product sustenance: Maintenance, updates, End of life, migration strategies.

Text Books

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook)
2. Software Engineering, Ian Somerville, 9th edition, Pearson education.
3. Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

Reference Books

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007
2. Software Engineering: Principles and Practice Hans van Vliet

Professional Elective -I

DSE201	Professional Elective -I (Data Science/ AIML/ Full Stack Development)	1L:0T:4P	3 Credits
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Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science / Artificial Intelligence and Machine Learning/ Full Stack Development**

VAC201	Yoga and Physical fitness /Sports/NCC/NSS/Disaster Management	0L:0T:4P	2 Credits
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Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

YOGA

Yoga course is designed to provide students with a comprehensive understanding of physical fitness, wellness, and nutrition. This course explores the meaning and importance of yoga in the modern era, the role of sports in maintaining physical fitness, and the various components of physical wellness. Students will also learn about the significance of nutrition and weight management, equipping them with the knowledge to promote a healthy and balanced lifestyle. Through this course, students will gain insights into the holistic approach to health and well-being.

Course Objective(s):

- Understand yoga's significance and its practical applications for holistic well-being.
- Explore subtle energy systems and their role in enhancing health through yogic practices.
- Examine various paths of yoga to foster self-realization and spiritual growth.
- Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.
- Apply yogic principles to manage psycho-somatic ailments and promote resilience.

Course Content:

Unit-I

- Yoga: Meaning and definition
- Importance of yoga in 21st century
- Introduction to Yogic Anatomy and Physiology
- Yoga & sports, Yoga for healthy lifestyle
- Types of Yoga: - Hatha yoga, laya yoga, mantra yoga, bhakti yoga, karma yoga, jnana yoga, raj yoga
- Study of Chakras, Koshas, Pranas, Nadis, Gunas, Vayus and its application in Yogic practices.
- Ashtang Yoga: - Yama, niyama, asana, pranayama, Pratyahar, dharna, dhyana, Samadhi : Benefits, Utilities & their psychological impact on body and mind. According to yoga concept of normality in modern psychology, concept of personality & its development, yogic management of psycho-somatic ailments: frustration, anxiety, depression

Unit-2

- Sports for Physical Fitness: Meaning and definition
- Physical Activity – Concept, Benefits of Participation in Physical Activities
- Components and Significance of Physical Fitness -Health, Skill and Cosmetic Fitness
- Types of Physical Activities – Walking, Jogging, Running, Calisthenics, Rope Skipping, Cycling, Swimming, Circuit Training, Weight training, Adventure Sports
- Principles of Physical Fitness, Warming Up, Conditioning, Cooling Down, Methods to Develop and Measure Health and Skill related components of Physical Fitness
- Measurement of Health Related Physical Fitness (HRPF)

Unit -3

- Physical Wellness: Concept, Components
- Types of wellness: psychological, social, emotional, and spiritual.
- Significance with reference to Positive Lifestyle 2.2
- Concepts of Quality of Life and Body Image
- Factors affecting Wellness
- Wellness Programmes

Unit-4: Nutrition and Weight Management

- Concept of Nutrients, Nutrition, Balanced Diet, Dietary Aids and Gimmicks
- Energy and Activity- Calorie Intake, Energy Balance Equation
- Obesity - Concept, Causes, Obesity Related Health Problems
- Weight Management through Behavioural Modifications

Text Books / References:

- Anand O P. Yog Dawra Kaya Kalp. Sewasth Sahitya Perkashan. Kanpur.
- Brown, J.E. Nutrition Now Thomson-Wadsworth.
- Corbin et.al.Fitness & Wellness-Concepts. McGraw Hill. Publishers. New York.U.S.A
- Corbin, C. B., G. J. Welk, W. R Corbin, K. A. Welk, Concepts of Physical Fitness: Active Lifestyle for Wellness. McGraw Hill, New York, USA.
- Hoeger, W W K and S.A. Hoeger. Principles and Labs for Fitness and Wellness, Thomson Wadsworth, California, USA.
- Hoeger, W.W. & S. Hoeger Fitness and Wellness. 7th Ed. Thomson Wadsworth, Boston, USA.
- Kamlesh, M. L. & Singh, M. K.) Physical Education (Naveen Publications).
- Kansal, D.K. Text book of Applied Measurement, Evaluation & Sports Selection. Sports & Spiritual Science Publications, New Delhi.
- Kumari, Sheela, S., Rana, Amita, and Kaushik, Seema,, Fitness, Aerobics and Gym Operations, Khel Sahitya, New Delhi
- Lumpkin, A. Introduction to Physical Education, Exercise Science and Sports Studies, McGraw Hill, New York, U.S.A.
- Sarin N) Yoga Dawara Rogon Ka Upchhar.Khel Sahitya Kendra
- Savard, M. and C. Svec The Body Shape Solution to Weight Loss and Wellness: The Apples & Pears Approach to Losing Weight, Living Longer, and Feeling Healthier. Atria Books, Sydney, Australia.
- Siedentop, D. Introduction to Physical Education, Fitness and Sport, McGraw Hill Companies Inc., New York, USA.
- Sri Swami Ramas. Breathing. Sadhana Mandir Trust.Rishikesh.
- Swami Ram Yoga & Married Life Sadhana Mandir Trust. Rishikesh

Course Outcome(s):

- i. Gain a comprehensive understanding of yoga and its modern applications for holistic well-being.
- ii. Demonstrate proficiency in yogic anatomy and physiology, enhancing yoga practice and promoting physical and energetic balance.

- iii. Master the Eight Limbs of Yoga and comprehend their psychological impact, fostering personal growth and self-realization.
- iv. Integrate yoga principles into sports and physical fitness activities to enhance performance and prevent injuries.
- v. Develop skills in wellness management and nutrition

Sports Management

Sports Management course is designed to provide undergraduate students with a broad, foundational understanding of the dynamic field of sports management. This course will familiarize students with the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations. Students will gain insights into the roles of marketing and sponsorship in the sports industry, as well as develop proficiency in financial management techniques specific to sports organizations. Additionally, the course will explore the application of analytics and technology in sports, enhancing the strategic decision-making and fan engagement capabilities.

Course Objective(s):

- i. Understand the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations.
- ii. Analyse the role of marketing and sponsorship in the sports industry, with a focus on branding, target audience segmentation, and event management.
- iii. Develop proficiency in financial management techniques specific to the sports industry, including revenue generation, cost management, and investment strategies.
- iv. Explore the application of analytics and technology in sports, including performance evaluation, strategic decision-making, and fan engagement.
- v. Apply theoretical knowledge to practical scenarios through case studies and projects, fostering critical thinking and problem-solving skills in sports management contexts.

Course Content:

Unit 1: Introduction to Sports Management

- Definition and scope of sports management
- Significance of sports management in society and its evolution over time
- Organizational structure of sports: amateur, professional, and non-profit entities
- Roles and responsibilities of key personnel: managers, coaches, and agents
- Governance bodies in sports: FIFA, IOC, and NCAA
- Legal issues: contracts, negotiations, intellectual property rights
- Ethical considerations: fair play and doping

Unit 2: Sports Marketing and Sponsorship

- Unique aspects of sports marketing
- Fan engagement strategies

- Target audience identification and segmentation
- Branding strategies for sports teams and athletes
- Sponsorship and endorsement deals
- Negotiating and managing partnerships
- Event management: planning, organizing, and promoting sports events

Unit 3: Financial Management in Sports

- Revenue generation in sports: ticket sales, broadcasting rights, merchandise sales
- Financial models: budgeting and forecasting
- Cost management: player salaries, facility expenses, operational costs
- Investment opportunities in sports
- Risk management techniques specific to sports organizations

Unit 4: Sports Analytics and Technology

- Introduction to sports analytics
- Evaluating player performance
- Devising game strategies
- Fan engagement through technology
- Analytical techniques: statistical analysis, data visualization, predictive modeling
- Key performance indicators (KPIs) in sports
- Applications of analytics: talent scouting, injury prevention, performance optimization.

Text Books :

1. Pedersen, P. M., Thibault, L., & Pedersen, P. M. (2019). Contemporary Sport Management. Human Kinetics.
2. Hoye, R., Smith, A. C. T., Nicholson, M., et al. (2021). Sports Management: Principles and Applications. Routledge.
3. Chelladurai, P., & Kerwin, S. (2017). Introduction to Sport Management: Theory and Practice. Human Kinetics.
4. Hoye, R., Cuskelly, G., & Nicholson, M. (2019). Sports Governance: A Guide for Sport Organizations. Routledge.
5. Conrad, M. (2018). The Business of Sports: A Primer for Journalists. Routledge.
6. Shank, M. D. (2019). Sports Marketing: A Strategic Perspective. Pearson.
7. Collett, P., & Fenton, W. (2019). The Sponsorship Handbook: Essential Tools, Tips and Techniques for Sponsors and Sponsorship Seekers. Kogan Page.
8. Fullerton, S. Jr., & Funk, D. C. (2019). Sports Marketing: A Practical Approach. Routledge.
9. Conrad, M. (2019). Winning in Sports Business: Essential Marketing, Finance, and Management Strategies. Routledge.
10. McCarty, L. A., & McPherson, G. (2019). Sports Event Management: The Caribbean Experience. Routledge.
11. Brown, M. T., Rascher, D., & Leeds, M. A. (2017). Financial Management in the Sport Industry. Routledge.
12. Winfree, J. A., & Rosentraub, M. S. (2017). Sports Finance and Management: Real Estate, Entertainment, and the Remaking of the Business. Taylor & Francis.

13. Foster, G., O'Reilly, N., & Cuskelly, G. (2018). Sports Business Management: Decision Making Around the Globe. Routledge.
14. Brown, M. T., & Shick, D. M. (2019). Financial Management in the Sport Industry. Routledge.
15. Conrad, M. (2018). The Business of Sports: A Primer for Journalists. Routledge.
16. Alamar, B. C. (2013). Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers. Columbia University Press.
17. Miller, T. W. (2019). Sports Analytics and Data Science: Winning the Game with Methods and Models. FT Press.
18. Marchi, M., Albert, J., & Baumer, B. (2014). Analyzing Baseball Data with R. Chapman and Hall/CRC.
19. Schumaker, R. P., Hwang, R. S. Y., & Chen, H. (2016). Sports Data Mining. Routledge.
20. Alamar, B. C. (2013). Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers. Columbia University Press.

References:

Course Outcome(s):

- i. Demonstrate a comprehensive understanding of sports management principles, including organizational structures, legal issues, and ethical considerations.
- ii. Evaluate marketing strategies and sponsorship opportunities in the sports industry, devising effective branding and promotional campaigns.
- iii. Apply financial management techniques to analyze revenue streams, control costs, and make informed investment decisions in sports organizations.
- iv. Utilize sports analytics tools and technology to enhance performance evaluation, strategic planning, and fan engagement initiatives.
- v. Synthesize course concepts through practical applications, demonstrating the ability to address real-world challenges in sports management scenarios.

National Cadet Corps (NCC)

This course develops essential skills in discipline, leadership, and tactical operations through structured curriculum and practical exercises. It emphasizes the role of drills in fostering discipline, leadership, and teamwork, and includes comprehensive weapon handling training with a focus on safety protocols. The course teaches map reading, understanding topographical features, and navigating diverse terrains. Practical units cover the history and objectives of the National Cadet Corps (NCC), various maneuvers, parade formations, saluting protocols, and field and battlecraft techniques. By the end, learners will master discipline, leadership, weapon handling, and tactical decision-making, effectively utilizing terrain features for strategic advantages.

Course Objective(s):

1. Understand the foundational role of drill in fostering discipline and leadership within a group, enabling effective command towards achieving common goals.
2. Appreciate the importance of grace and dignity in executing foot drill movements, recognizing their significance in enhancing performance and teamwork.
3. Comprehend the criticality of weapon handling and detailed safety measures, emphasizing the importance of accident prevention through strict adherence to safety protocols.
4. Develop an awareness of diverse terrain types and their strategic significance in battle craft, enabling informed decision-making and effective utilization of terrain features for tactical advantage.

Course Content (Practical):

Unit 1:

Overview of NCC, its history, aims, objectives, and organizational structure, Incentives and duties associated with NCC cadetship; Maneuvers: Foot drill, Word of Command, Attention, and stand at ease, and Advanced maneuvers like turning and sizing; Parade formations: Parade line, open line, and closed line; Saluting protocols, parade conclusion, and dismissal procedures. Marching styles: style march, double time march, and slow march

Unit 2:

Weapon Training, Handling firearms, Introduction and characteristics of the .22 rifle; Handling Firearm techniques, emphasizing safety protocols and Best practices.

Unit 3:

Map Reading (MR): Topographical forms and technical terms, including relief, contours, and gradients, crucial for understanding terrain features; Cardinal points, magnetic variation and grid convergence

Unit 4:

Field Craft & Battle Craft (FC & BC): Fundamental principles and techniques essential for effective field and battle craft operations; Methods of judging distance, including estimation, pacing, and visual cues

References:

- DGNCC Cadet's Hand Book - Common Subjects -All Wings
- Tiwari, R. (2019). NCC: Grooming Feeling of National Integration, Leadership and Discipline among Youth. Edwin Incorporation.
- Chhetri, R.S. (2010). Grooming Tomorrows Leaders, The National Cadet Corps.
- [Directorate General National Cadet Corps](#) (2003). National Cadet Corps, Youth in Action.
- Vanshpal, Ravi (2024). The NCC Days, Notion Press.

Course Outcome(s):

1. Mastery of Discipline and Leadership through Drill Learners would demonstrate the ability to effectively command a group, foster discipline, and work collaboratively towards achieving shared objectives.

2. Mastery of Grace and Dignity in Foot Drill Performance Learners would demonstrate an understanding of how these qualities enhance performance and foster teamwork within a group setting.
3. Proficient Weapon Handling and Safety Adherence Learners would showcase a thorough understanding of the criticality of safety measures, emphasizing accident prevention through strict adherence to safety protocols.
4. Enhanced Tactical Awareness and Strategic Decision-Making Learners would gain the ability to make informed decisions and effectively utilize terrain features to gain tactical advantage during operations.

National Service Scheme (NSS)

This course provides students with an in-depth understanding of the National Service Scheme (NSS), including its history, philosophy, aims, objectives, and organizational structure. It equips students with knowledge about various NSS programmes and activities, emphasizing their relevance and importance. The course also develops skills in community mobilization, teaching students effective techniques for engaging and mobilizing community stakeholders. Additionally, it cultivates an appreciation for volunteerism and shramdan (voluntary labor), highlighting their role in community development initiatives. By the end of the course, students will have a comprehensive understanding of NSS, enhanced leadership and team-building skills, and a strong sense of social awareness and patriotism.

Course Objective(s):

1. To provide students with an understanding of the history, philosophy, and basic concepts of the National Service Scheme (NSS).
2. To familiarize students with the aims, objectives, and organizational structure of NSS.
3. To equip students with knowledge about NSS programmes, activities, and their relevance.
4. To develop an understanding of community mobilization techniques and their importance in NSS activities.
5. To cultivate an appreciation for volunteerism, shramdan (voluntary labor), and their role in community development initiatives.

Course Content:

Unit 1: Introduction and Basic Concepts of NSS

National Service Scheme (NSS) - history, philosophy, and fundamental concepts, aims and objectives, providing clarity on the organization's overarching goals. Symbols of NSS - Emblem, flag, motto, song, and badge; Organizational structure of NSS

Unit 2: NSS Programmes and Activities

Diverse programmes and activities conducted under the aegis of the National Service Scheme (NSS); Significance of commemorating important days recognized by the United Nations, Centre, State Government, and University; Examination of the methodology for adopting villages/slums and conducting surveys; Financial patterns of the NSS scheme

Unit 3: Community Mobilization

Dynamics of community mobilization within the framework of the National Service Scheme (NSS); Functioning of community stakeholders; The conceptual lens of community development

Unit 4: Volunteerism and Shramdan in the Indian Context: Roles and Motivations within the NSS Framework

Ethos of volunteerism and shramdan (voluntary labor) within the cultural context of India and the framework of the National Service Scheme (NSS); Motivations and constraints shaping volunteer engagement; Role of NSS volunteers in initiatives such as the Swachh Bharat Abhiyan and Digital India

References:

1. Ministry of Youth Affairs and Sports, Government of India. (2022). National Service Scheme (NSS) Manual.
2. Agarwalla, S. (2021). NSS and Youth Development. Mahaveer Publications
3. Bhattacharya, P. (2024). Stories Of NSS (English Version). Sahityasree.
4. Borah, R. and Borkakoty, B. (2022). NSS in Socioeconomic Development. Unika Prakashan.
5. Wondimu, H., & Admas, G. (2024). The motivation and engagement of student volunteers in volunteerism at the University of Gondar. *Discover Global Society*, 2(1), 1-16.
6. Saha, A. K. (2002). Extension Education–The Third Dimension Needs and Aspirations of Indian Youth. *Journal of Social Sciences*, 6(3), 209-214.
7. Mills, S. (2013). “An instruction in good citizenship”: scouting and the historical geographies of citizenship education. *Transactions of the Institute of British Geographers*, 38(1), 120–134. <http://www.jstor.org/stable/24582445>
8. Mishra, S. K., Sachdev, S., Marwaha, N., & Avasthi, A. (2016). Study of knowledge and attitude among college-going students toward voluntary blood donation from north India. *Journal of blood medicine*, 19-26.
9. Mukherji, B. (2007). Community Development in India. Orient Longmans.
10. History Background of NSS and its Philosophy, Aims and Objectives
11. <https://www.osmania.ac.in/NSS%20URL/9.%20%20Historical%20Background%20of%20NSS%20and%20its%20Philosophy,%20Aim.pdf>
12. In Defence of Nationalism <https://www.mk gandhi.org/indiadreams/chap03.htm>
13. Unlocking Youth Potential for Nation Building: Strengthening NYKS and NSS
14. <https://www.undp.org/india/projects/strengthening-nyks-and-nss>

Course Outcome(s):

1. Students will demonstrate an understanding of the history, philosophy, and objectives of the National Service Scheme (NSS), thereby fostering increased social awareness and patriotism among them.
2. Students will be able to organize and conduct various NSS programmes and activities effectively and through it understand the importance of leadership and team building.
3. Students will develop skills in community mobilization and partnership building.

4. Students will appreciate the importance of volunteerism and shramdan in societal development and thus, be able to understand role of community participation.

DISASTER MANAGEMENT

In our rapidly evolving 21st-century world, challenges emerge in diverse forms, transcending borders and intertwining economic, societal, and environmental realms. These challenges profoundly affect vulnerable communities, magnifying their susceptibility to climate-related shocks and disasters. As we navigate through these complexities, it becomes increasingly evident that aligning strategies with global Sustainable Development Goals (SDGs) across various geographical scales is paramount. This alignment incorporates perspectives of environmental sustainability, climate adaptation, and disaster resilience. In light of these considerations, this course aims to equip students with the knowledge and skills necessary to address and mitigate the impacts of disasters in a holistic manner.

Course Objective(s):

- to provide understanding of the concepts related to disaster
- to highlight the importance and role of disaster management
- to enhance awareness of institutional processes and management strategies to mitigate the impacts of disasters

Course Content:

Unit 1: Concepts and Terminologies

Understanding key concepts of Hazards, disasters; Disaster types and causes (Geophysical, Hydrological, Meteorological, Biological and Atmospheric; Human-made); Global trends in disasters - Impacts (Physical, Social, Economic, Political, Environmental and Psychosocial); Defining Vulnerability (Physical Vulnerability; Economic Vulnerability; Social Vulnerability)

Unit 2: Key concepts of Disaster Management Cycle

Components of disaster management cycle (Phases: Response and recovery, Risk assessment, Mitigation and prevention, Preparedness planning, Prediction and warning); Disaster risk reduction (DRR), Community based disaster risk reduction

Unit 3: Initiatives at national and international level

Disaster Risk Management in India and at international level: Related policies, plans, programmes and legislation; International strategy for disaster reduction and other initiatives

Unit 4: Emergency Management

Explosion and accidents (Industrial, Nuclear, Transport and Mining) - Spill (Oil and Hazardous material); Threats (Bomb and terrorist attacks) - Stampede and conflicts

Training and Demonstration Workshops (at least two workshops) be organized in association with the NIDM, NDRF, NCDC, Param Military, Fire Brigade, CISF, local administration etc.

Readings

1. Sharma, S.C. (2022), Disaster Management, Khanna Book Publishing.
2. Clements, B. W., (2009): Disasters and Public Health: Planning and Response, Elsevier Inc.
3. Dunkan, K., and Brebbia, C. A., (Eds.) (2009): Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK.
4. Singh, R. B. (ed.), (2006) Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.
5. Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Modh, S. (2010) Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.
7. Carter, N. (1991) Disaster Management: A Disaster Management Handbook. Asian Development Bank, Manila.
8. Govt. of India (2008) Vulnerability Atlas of India. BMTPC, New Delhi.
9. Govt. of India (2011) Disaster Management in India. Ministry of Home Affairs, New Delhi.
10. Matthews, J.A., (2002) Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.

E-Resources

<http://www.ndma.gov.in/en/>
<http://nidm.gov.in/>
<https://www.unisdr.org/>
<http://www.emdat.be>
<https://www.weather.gov/safety/>
<https://www.preventionweb.net/risk/vulnerability>

Course Outcomes:

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

- i. Articulate the critical role of disaster management in reducing risks and enhancing resilience
- ii. Identify and describe key institutional frameworks and processes in disaster management.
- iii. Conduct risk assessments and develop disaster management plans for specific scenarios

SEMESTER –IV

SEMESTER –IV

Entrepreneurship and Startup Ecosystem

CC 204	Entrepreneurship and Startup Ecosystem	1L:1T:0P	2 Credits
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Course Objective(s):

- To understand Entrepreneurship and its types
- To understand that not all ideas can be turned into viable business models and guestimate business potential of an idea
- To understand different type of finances available and financing methods
- To be able to draft business plans on an identified idea
- To understand the nuances of operating a startup – low budget marketing, stabilizing operations, build a team from scratch and scaling the business
- To know what is a Family Business and how is it different from Entrepreneurship

Course Content:

Unit 1: Introduction to Entrepreneurship & Family Business

- Definition and Concept of entrepreneurship
- Entrepreneur Characteristics
- Classification of Entrepreneurs
- Role of Entrepreneurship in Economic Development –Start-ups
- Knowing the characteristics of Family business with discussion on few Indian cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.

Unit 2: Evaluating Business opportunity

- Sources of business ideas and opportunity recognition
- Guesstimating the market potential of a business idea
- Feasibility analysis of the idea
- Industry, competition and environment analysis

Unit 3: Building Blocks of starting ventures

- Low cost Marketing using digital technologies
- Team building from scratch
- Venture Funding
- Establishing the value-chain and managing operations
- Legal aspects like IPR and compliances

Unit 4: Start-up Ecosystem

- Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc.
- Know various govt. schemes like Start-up India, Digital India, MSME etc.
- Sources of Venture Funding available in India
- Source of Technology, Intellectual Property management

Text Books (Latest Edition):

1. *Startup India Leaning Program* by Start Up India available at www.startupindia.gov.in

2. *Entrepreneurship*, Rajeev Roy, Oxford University Press
3. *Entrepreneurship: Successfully Launching New Ventures* by R. Duane Ireland Bruce R. Barringer, Pearson Publishing
4. *Family Business Management* by Rajiv Agarwal, Sage Publishing
5. Anish Tiwari (2003), “Mapping the Startup Ecosystem in India”, *Economic & Political Weekly*
6. Ramachandran, K, *Indian Family Businesses: Their survival beyond three generations*, ISB Working Paper Series

References

Course Outcome(s):

At the end of the course, the student would be able to -

- Understand basic building blocks of creating a venture
- Be able to identify a business opportunity and translate it into a viable business model
- Identify the elements of the Indian entrepreneurship ecosystem and take relevant benefits from the constituents
- Know the legacy of family businesses and key differentiations from entrepreneurship

Computer Networks

CC205	Computer Networks	3L:0T:4P	5 Credits
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Course Objectives:

- CO1: Understand the fundamental concepts of Computer Networks and their applications.
CO2: Develop problem-solving skills related to network design, implementation, and troubleshooting.
CO3: Implement network protocols and configure network devices.

Prerequisites:

1. Basic Networking Knowledge: Familiarity with basic networking concepts such as IP addressing and network topologies.
2. Programming Skills: Ability to write basic network programs and scripts in languages such as Python or C.
3. Operating Systems: Understanding of OS concepts related to networking, such as process management and memory allocation

Course Content:

UNIT I: Introduction to Computer Networks

Overview of Computer Networks: Definition and Objectives, Applications and Examples
Network Components and Architecture

Network Models: OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions

Comparison between OSI and TCP/IP Models

Network Topologies: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology

Data Transmission: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency

Networking Devices: Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.

UNIT II: Data Link Layer and Networking Protocols

Data Link Layer Fundamentals: Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms.

Ethernet: Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods

Network Protocols: Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation

Address Resolution Protocol (ARP): ARP Operation and Table, ARP Spoofing and Security Considerations

Virtual LANs (VLANs): Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases

UNIT III: Network Layer and Transport Layer

Network Layer: IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT)

Transport Layer: TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP

Congestion Control Algorithms: Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas.

Quality of Service (QoS): QoS Principles and Mechanisms, Differentiated Services (DiffServ) and Integrated Services (IntServ)

Network Security Fundamentals: Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption

UNIT IV: Application Layer and Emerging Technologies

Application Layer Protocols: HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution

Network Applications: Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming.

Emerging Technologies: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking

Network Management: SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques.

Future Trends in Networking: 5G and Beyond, Network Automation and Artificial Intelligence in Networking.

Text Books:

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.

Reference Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.
2. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.
3. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023.
4. Mastering PC Hardware & Networking, Khanna Publishing House, 2024.

Web Resources:

1. Cisco Networking Academy - Online Courses and Resources
2. NetworkLessons.com - Tutorials on Various Networking Topics

Lab Programs:

1. Configure Basic Network Settings:
 - a) IP Address Configuration
 - b) Subnet Mask and Gateway Settings
2. Implement Network Protocols:
 - a) Write a simple Python script to perform DNS resolution.
 - b) Implement a basic HTTP client-server application.
3. Network Simulation:
 - a) Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies.
 - b) Configure routers and switches in a simulated environment.
4. Performance Measurement:
 - a) Measure network performance using tools like `ping`, `traceroute`, and `iperf`.
 - b) Analyze network traffic using Wireshark.
5. Implement VLANs:
 - a) Configure VLANs on a switch and verify using simulation tools.
6. Set Up a Simple Web Server:
 - a) Deploy a basic web server and configure HTTP/HTTPS access.
7. Network Security Lab:
 - a) Implement basic firewall rules and VPN configurations.
 - b) Perform vulnerability scanning and analyze results.
8. Network Troubleshooting:
 - a) Diagnose and resolve common network issues.
 - b) Use troubleshooting commands and techniques to fix connectivity problems.

Design and Analysis of Algorithms

CC206	Design and Analysis of Algorithms	3L:0T:0P	3 Credits
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Course Objectives

CO1: This course envisions to impart to students the understanding of basic algorithm designing paradigms.

CO2: This course introduces the basic knowledge on how to analyse an algorithm.

CO3: This course expects to enable a student to synthesize efficient algorithms in common design situations and real-life problems.

Prerequisite: Knowledge of Data Structures

Course Content:

UNIT I:

What is an algorithm? Design and performance analysis of algorithms, time complexity, space complexity.

Asymptotic notations (O , Ω , Θ) to measure growth of a function and application to measure complexity of algorithms.

Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication.

Recursion: Basic concept. Analysis of recursive algorithms, Master's theorem.

UNIT II:

The Divide & Conquer Design Technique:

The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication.

Lower bound for comparison-based sorting.

The Greedy Design Technique:

The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.

UNIT III:

The Dynamic Programming Design Technique:

The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem.

Algorithms on Graphs:

Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.

UNIT IV:

Limitations of Algorithmic Power:

Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit

problem/vertex cover problem.

Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.

Text Books

1. Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
2. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.
3. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012.
4. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson, 2012

Reference Books

1. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983.
2. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006.

Web Resources

1. <https://nptel.ac.in/courses/106101060>
2. <https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf>

Artificial Intelligence

CC207	Artificial Intelligence	3L:0T:4P	5 Credits
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Prerequisites:

Basic understanding of computer science concepts, including data structures and algorithms. Proficiency in minimum one programming language, such as Python.

Course Content:

UNIT I: Introduction to AI

What is AI? Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents. Knowledge-Based Agents: Introduction to Knowledge-Based Agents, The Wumpus World as an Example World. Problem-solving: Problem-solving agents.

UNIT II: Advanced Search Techniques

Uninformed Search: DFS, BFS, Iterative Deepening Search. Informed Search: Best First Search, A* search, AO* search. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning. Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. Evolutionary Search Techniques: Introduction to evolutionary algorithms, Genetic algorithms, Applications of evolutionary search in AI.

UNIT III: Logical Reasoning and Uncertainty

Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting. Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems. Introduction to Planning: Blocks World problem, Strips; Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning, Introduction to Fuzzy set theory.

UNIT IV: Domains and Applications of AI

Domains in AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Deep Neural Networks, and their Applications. Expert Systems: The architecture and role of expert systems include two case studies. Legal and Ethical Issues: Concerns related to AI.

Text Books:

1. M.C. Trivedi, *A Classical Approach to Artificial Intelligence*, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook).
2. Nilsson Nils J, *Artificial Intelligence: A new Synthesis*, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
3. Dan W Patterson, *Introduction to Artificial Intelligence & Expert Systems*, PHI Learning 2010.
4. Rajiv Chopra, *Data Science with Artificial Intelligence, Machine Learning and Deep Learning*, Khanna Book Publishing Company, 2024.

Reference Books:

1. M.C. Trivedi, *Introduction to AI and Machine Learning*, Khanna Book Publishing Company, 2024.
2. Russell, S. and Norvig, P., “Artificial Intelligence - A Modern Approach”, 3rd edition, Prentice Hall
3. Van Hirtum, A. & Kolski, C. (2020). *Constraint Satisfaction Problems: Algorithms and Applications*. Springer
4. Rajiv Chopra, *Machine Learning and Machine Intelligence*, Khanna Book Publishing Company, 2024.

Course Outcomes:

- CO1: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents.
- CO2: Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications.
- CO3: Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning.
- CO4: Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets.
- CO5: Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI

Artificial Intelligence Lab

Prerequisites: Basic understanding of algorithms and data structures (e.g., trees, graphs, lists). Proficiency in Python programming, including libraries like NLTK for NLP tasks.

LAB Experiments

The lab experiments may be implemented in Python. Libraries like NLTK, Tensorflow and Keras may be used for Machine learning experiments.

Suggested list of Experiments (not limited to):

1. Demonstrate basic problem-solving using Breadth-First Search on a simple grid.
2. Implement Depth-First Search (DFS) on a small graph.
3. Solve the Water Jug Problem using Breadth First Search (BFS).
4. Implement a Hill Climbing search to find the peak in a numeric dataset.
5. Apply the A* Search algorithm to find the shortest path in a 4x4 grid.
6. Implement the Minimax search algorithm for 2-player games. You may use a game tree with 3 plies.
7. Solve the 4 – Queens Problem as a CSP backtracking problem.
8. Use constraint propagation to solve a Magic Square puzzle.
9. Apply optimization techniques to find the maximum value in a list.
10. Represent and evaluate propositional logic expressions.
11. Implement a basic rule-based expert system for weather classification.
12. Implement a basic AI agent with simple decision-making rules.
13. Implement a basic Rule-Based Chatbot.
14. Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content.
 - a) Tokenizing
 - b) Filtering Stop Words
 - c) Stemming
 - d) Part of Speech tagging
 - e) Chunking
 - f) Named Entity Recognition (NER)
15. Perform Image classification for a given dataset using CNN. You may use Tensorflow /Keras.

Course outcomes:

- CO1: Apply Uninformed Search Algorithms and Implement Heuristic Search techniques
- CO2: Analyze and Solve Constraint Satisfaction Problems
- CO3: Develop Rule-Based Systems
- CO4: Implement and Evaluate Optimization Techniques
- CO5: Apply and illustrate the NLP concepts

Professional Elective -II

DSE202	Professional Elective -I (Data Science/ AIML/ Full Stack Development)	1L:0T:4P	3 Credits
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Refer to **Appendix-I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning/ Full Stack Development.**

SEC 202	Design Thinking and Innovation	1L:1T:0P	2 Credits
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Course Objectives:

Operating under turbulent and uncertain business environment, 'innovation' has become the key driver of organizational success for all companies. Managers are expected to be leading this change by navigating companies into rapid evolution of new products/services and business models.

The primary focus of DTI is to help learners develop creative thinking skills and apply design based approaches/tools for identifying and implementing innovation opportunities into implementable projects. Following a learning-by-doing approach, the objectives of the course are –

1. Introduce students to design-based thinking approach to solve problems
2. Observe and assimilate unstructured information to well framed solvable problems
3. Introduce student to templates of ideation
4. Understand the importance of prototyping in the innovation journey
5. Implementing innovation projects

Course Content:

Unit 1: Basics of Design Thinking

1. Understand the concept of innovation and its significance in business
2. Understanding creative thinking process and problem solving approaches
3. Know Design Thinking approach and its objective
4. Design Thinking and customer centricity – real world examples of customer challenges, use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product.
5. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc.
6. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement

Unit 2: Learning to Empathize and Define the Problem

1. Know the importance of empathy in innovation process – how can students develop empathy using design tools

2. Observing and assimilating information
3. Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences.
4. What are wicked problems
5. Identifying wicked problems around us and the potential impact of their solutions

Unit 3 : Ideate, Prototype and Implement

1. Know the various templates of ideation like brainstorming, systems thinking
2. Concept of brainstorming – how to reach consensus on wicked problems
3. Mapping customer experience for ideation
4. Know the methods of prototyping, purpose of rapid prototyping.
5. Implementation

Unit 4 : Feedback, Re-Design & Re-Create

1. Feedback loop, focus on User Experience, address ergonomic challenges, user focused design
2. Final concept testing,
3. Final Presentation – Solving Problems through innovative design concepts & creative solution

Text Books (Latest Edition):

1. E Balaguruswamy (2023), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company
2. Tim Brown, (2008), “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, *Harvard Business Review*
3. 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing

Reference Book

1. Design Thinking by Nigel Cross, Bloomsbury

Course Outcome(s):

By the end of the course, students will be able to –

- Propose real-time innovative product designs and Choose appropriate frameworks, strategies, techniques during prototype development.
- Know wicked problems and how to frame them in a consensus manner that is agreeable to all stakeholders using appropriate frameworks, strategies, techniques during prototype development.
- Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products

SEMESTER –V

DSE-301: INTRODUCTION TO DATA SCIENCE

Course Objectives:

- To learn emerging issues related to various fields of data science.
- To understand the underlying principles of data science, exploring data analysis.
- To learn the basics of R Programming.

Course Outcomes:

After completion, students will be able to:

- Explain the data science lifecycle and tools
- Perform data manipulation and analysis using R
- Acquire and clean data from multiple sources
- Apply exploratory data analysis techniques to derive insights

Unit-1

Data Scientist's Tool Box: Turning data into actionable knowledge, introduction to the tools that will be used in building data analysis software: version control, markdown, git, GitHub, R, and RStudio.

Unit-2

R Programming Basics: Overview of R, R data types and objects, reading and writing data, Control structures, functions, scoping rules, dates and times, Loop functions, debugging tools, Simulation, code profiling.

Unit-3

Getting and Cleaning Data: Obtaining data from the web, from APIs, from databases and from colleagues in various formats, basics of data cleaning and making data "tidy".

Unit-4

Exploratory Data Analysis: Essential exploratory techniques for summarizing data, applied before formal modeling commences, eliminating or sharpening potential hypotheses about the world that can be addressed by the data, common multivariate statistical techniques used to visualize high-dimensional data.

Text Book:

1. Rachel Schutt, Cathy O'Neil, "Doing Data Science: Straight Talk from the Frontline" by Schroff/O'Reilly, 2013.

Reference Books:

2. Foster Provost, Tom Fawcett, "Data Science for Business" What You Need to Know About Data Mining and Data-Analytic Thinking by O'Reilly, 2013.
3. John W. Foreman, "Data Smart: Using data Science to Transform Information into Insight" by John Wiley & Sons, 2013.
4. Eric Seigel, "Predictive Analytics: The Power to Predict who Will Click, Buy, Lie, or Die", 1st Edition, by Wiley, 2013.

DSE-301: DATA SCIENCE PRACTICAL LAB

1. Write a program that prints "Hello World" to the screen.
2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
3. Write a program that prints a multiplication table for numbers up to 12.
4. Write a function that returns the largest element in a list.
5. Write a function that computes the running total of a list.

6. Write a function that tests whether a string is a palindrome.
7. Implement linear search.
8. Implement binary search.
9. Implement matrices addition, subtraction and Multiplication
10. Fifteen students were enrolled in a course. Their ages were: 20 20 20 20 20 21 21 21 22 22 22 22 23 23 23
 - i. Find the median age of all students under 22 years
 - ii. Find the median age of all students
 - iii. Find the mean age of all students
 - iv. Find the modal age for all students
 - v. Two more students enter the class. The age of both students is 23. What is now mean, mode and median?

DSE302: TIME SERIES ANALYSIS

Course Objectives

- Introduce the concept of time series, its components, and their estimation.
- Introduce the application of time series.

Course Outcomes

- After completion of this course, the students will be able to:
- Understand the concepts of time series.
- Formulate, solve, and analyze the use of time series for real-world problems.

Unit 1: Fundamentals of Time Series

Introduction: Definition, importance, and applications of Time Series in Computer Science and Business.

Components of Time Series: Understanding the "Four Forces": Secular Trend (Long-term movement), Seasonal Variations (Short-term periodic patterns), Cyclical Variations (Long-term oscillations), Irregular/Random Fluctuations. Mathematical Decomposition: Additive and Multiplicative models (Concepts, Merits, and Demerits).

Unit 2: Measurement of Trend

Non-Mathematical Methods: Free-hand Curve and Method of Semi-Averages.

Mathematical Methods (Least Squares): Fitting of Linear Trend ($y = a + bx$), Fitting of Second-Degree Parabolic (Quadratic) Curves, Introduction to Exponential Trend fitting.

Moving Average Method: Calculation of 3-yearly, 4-yearly (centered), and 5-yearly moving averages.

Unit 3: Seasonal Variations & Growth Curves

Seasonal Indices: * Method of Simple Averages, Ratio-to-Trend Method, Ratio-to-Moving Average Method.

Growth Curves in IT: Conceptual understanding of Modified Exponential, Gompertz, and Logistic (S-curve) models for growth prediction.

Unit 4: Introduction to Forecasting & Errors

Smoothing Techniques: Simple Exponential Smoothing (Holt's logic) for short-term forecasting.

Stationarity: Basic concept of a "stable" time series (Mean and Variance).

Forecasting Accuracy: How to measure if a model is correct: MAE (Mean Absolute Error), MSE (Mean Squared Error), RMSE (Root Mean Squared Error)

Modern Overview: A brief look at the Box-Jenkins (ARIMA) approach and the role of "White Noise."

Recommended Reference Books

1. S.C. Gupta & V.K. Kapoor: *Fundamentals of Applied Statistics*.
2. S.P. Gupta: *Statistical Methods*.
3. B.L. Agarwal: *Basic Statistics*.

DSE302: TIME SERIES ANALYSIS PRACTICAL:

1. Visual Component Identification: Identifying Trend, Seasonality, and Irregular peaks in a given time series graph.
2. The Method of Semi-Averages: Calculating the trend line by splitting a dataset into two equal halves.
3. Linear Trend Fitting: Using the Method of Least Squares to find the straight-line equation $y = a + bx$.
4. Data Smoothing: Calculating 3-Year and 5-Year Moving Averages to remove short-term fluctuations.
5. Seasonal Index Calculation: Using the Method of Simple Averages to find seasonal variations.
6. Ratio-to-Moving Average: Calculating seasonal indices by comparing actual data to centered moving averages.
7. Growth Curve Analysis: Sketching and identifying the Logistic (S-curve) and Gompertz curves in population or technology data.
8. Short-term Forecasting: Applying Simple Exponential Smoothing to predict the next value in a sequence.
9. Forecasting Accuracy (MAE): Calculating the Mean Absolute Error to check the reliability of a prediction.
10. Error Diagnostics: Performing Residual Analysis to check if the remaining errors represent random "White Noise."

DSE303: MACHINE LEARNING

Course Objectives

- Present foundations of Machine Learning algorithms and real-world applications.
- Cover major learning approaches: supervised and unsupervised.

Course Outcomes

Upon successful completion, students will be able to:

- Differentiate between supervised and unsupervised learning tasks.
- Normalize data and perform outlier analysis.
- Execute various ML algorithms (regression, clustering, dimensionality reduction).

Unit I: Introduction to Machine Learning

Definition, History, Future and basic concepts of Machine Learning, Key elements of

Machine Learning, Supervised vs. Unsupervised Learning. Mathematical Foundations: Data Structures for linear Algebra, Tensor Operations, matrix properties, Eigenvectors and Eigenvalues, Matrix operations for Machine Learning.

Unit II: Supervised Learning - I

Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Over-fitting and Bias-Variance Trade-off, regularization. Regression evaluation metrics. Linear Discriminant Analysis.

Unit III: Supervised Learning - II

Logistic Regression, Naïve Bayes Classifier, K-Nearest Neighbour (K-NN), Support Vector Machine (SVM), Kernel SVM, Decision Tree Classifier, Evaluating Classification Model Performance.

Unit IV: Unsupervised Learning

Clustering: Approaches for clustering, distance metrics, K-means clustering, hierarchical clustering, and feature selection methods. Dimensionality reduction (Principal Component Analysis). Association Rules Learning.

Recommended Reference Books :

1. Alpaydin, E. (2020). Introduction to machine learning. MIT press.
2. Mathematical Foundation of Machine Learning: A Comprehensive Exploration.
3. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An introduction to statistical learning. Springer.
4. Raschka, S., & Mirjalili, V. (2019). Python machine learning. Packt Publishing Ltd.
5. Shalev-Shwartz, S., & Ben-David, S. (2014). Understanding machine learning. Cambridge University Press.

DSE303: MACHINE LEARNING PRACTICAL:

1. Implement linear algebra operations (matrix multiplication, eigenvectors) using NumPy.
2. Develop programs for Simple, Multiple, and Polynomial Linear Regression.
3. Implement Ridge and Lasso regression (regularization).
4. Implement LDA for dimensionality reduction.
5. Develop KNN algorithm from scratch and evaluate performance.
6. Create a Decision Tree Classifier for classification problems.
7. Implement K-Means and Hierarchical clustering on unlabeled datasets.
8. Perform Principal Component Analysis (PCA) for dimensionality reduction and visualization.

SEC302: QUANTITATIVE TECHNIQUES

Course Objectives

- To reinforce basic math concepts and ideas.
- To enhance reasoning power and problem-solving capacity through indirect math problems.
- To develop logical thinking.
- To make learners competent for competitive and entrance examinations.

Course Outcomes

- Understand integers, rational numbers, real numbers and their operations.
- Learn concepts of GCD and LCM.
- Understand averages (AM, GM, HM) and percentages.
- Evaluate ratios and proportions.
- Understand Profit, Loss, and related percentages.
- Learn concepts related to Time, Speed, and Distance.

UNIT- 1: Elementary Arithmetic - I

Numbers and BODMAS: Review of number systems, basic operations, and calculation tricks (GCD, LCM). Averages and Percentage: AM, GM, HM properties and inequalities; Percentages.

Ratio and Proportion: Concepts and properties (invertendo, componendo, etc.); Direct and Inverse proportion.

UNIT-2: Elementary Arithmetic - II

Profit and Loss: Definitions, Percentage Profit/Los; Time, Speed and Distance: Average speed, crossing objects (pole vs. tunnel), moving vs. stationary objects, river currents.

Work, Pipes and Cisterns: Work rate logic, filling and emptying cisterns.

Recommended Reference Books :

1. Quantitative Aptitude for Competitive Examinations by R. S. Aggarwal.
2. Bible To Basic Mathematics by Pragati Agarwal.
3. Logical and Analytical Reasoning: Useful for All Competitive Exams by A. K. Gupta.
4. Arithmetic: Subjective And Objective For Competitive Examinations by R. S. Aggarwal.
5. Maths Book For Competitive Exams by Vikas Bhalla.
6. Reasoning For Competitive Examinations by Nishit K. Sinha.

SEMESTER –VI

CC301: GENERATIVE AI

Course Objectives:

- To provide a clear understanding of the fundamental concepts of Artificial Intelligence, including its history and different classifications.
- To explain the technological hierarchy between AI, Machine Learning (ML), and Deep Learning (DL).
- To introduce the mechanics of Generative AI and the underlying role of neural networks and training data.
- To equip students with the basic techniques of Natural Language Processing (NLP) for text data preparation.
- To demystify Large Language Models (LLMs) and Transformers, focusing on their operational logic and inherent limitations.

Course Outcomes

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

- Differentiate between various types of AI (Narrow, General, and Super) and identify their applications in the real world.
- Explain the relationship and boundaries between AI, Machine Learning, and Deep Learning.

UNIT I

What is Artificial Intelligence? History and evolution of AI, Types of AI, Narrow AI, General AI, Super AI, Real-world examples of AI, Difference between AI, Machine Learning, and Deep Learning

UNIT II

What is Generative AI? How generative models work. Introduction to neural networks. Basics of deep learning. Concept of training data. Understanding tokens and embeddings (basic level).

UNIT III

What is NLP? Text preprocessing, Tokenization, Stop words, Stemming & lemmatization, Bag of Words (BoW), TF-IDF (intro level).

UNIT IV

What are Large Language Models? How models like ChatGPT work (high level), Transformers – simple explanation, Training vs inference, Limitations of LLMs.

Recommended Books:

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig.
2. Generative AI with LangChain by Ben Auffarth.
3. Speech and Language Processing by Dan Jurafsky and James H. Martin.

CC301: GENERATIVE AI PRACTICAL:

1. AI Classification Challenge: Analyze a list of 10 modern technologies (e.g., Tesla Autopilot, Spotify Discover Weekly, Google Translate) and classify them into Narrow AI, General AI, or Super AI.
2. Visualizing the AI Hierarchy: Create a diagram or map that correctly places specific techniques like "Decision Trees" and "Convolutional Neural Networks" into the correct circles of AI, Machine Learning, or Deep Learning.
3. Generative Prompt Testing: Use an image generator (like Midjourney or DALL-E) to generate the same subject (e.g., "a cat in space") using three different levels of detail in the prompt to observe how the model "imagines" details.
4. Tokenization & Cleaning: Take a raw dataset of tweets and perform manual Tokenization and Stop Word removal to see how much "noise" is removed before a machine reads it.
5. Stemming vs. Lemmatization: Use a simple text set to apply both techniques. Compare how "Changing," "Changed," and "Changes" are handled by each to understand which is more "intelligent."
6. Bag-of-Words (BoW) Matrix: Create a simple 3x3 table (Document-Term Matrix) for three sentences to see how words are converted into the numerical vectors that computers understand.
7. Embedding Proximity: Use a word embedding visualizer to find "neighbor" words. For example, see how "King" is mathematically related to "Man" and "Queen" is related to "Woman."
8. The Transformer "Attention" Exercise: Take a sentence with a pronoun (e.g., "The bank was closed because *it* was a holiday") and identify which words the model must "pay attention" to in order to know what "*it*" refers to.
9. Prompt Engineering Techniques: Practice Few-Shot Prompting by giving an LLM three examples of a task before asking it to do a fourth, and compare the result to a prompt with no examples.
10. LLM Hallucination Audit: Ask an LLM to write a biography of a "famous" person you just made up. Document how the model "hallucinates" facts to fill in the gaps, demonstrating its current limitations.

DSE304: BIG DATA ANALYSIS

Course Objectives:

- To introduce the fundamental concepts of Big Data and its importance in modern computing
- To understand different types of data and challenges associated with large-scale data processing
- To familiarize students with the Hadoop ecosystem and distributed computing frameworks
- To develop basic skills in NoSQL databases and MapReduce programming

Course Outcomes

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

- Explain the characteristics, challenges, and applications of Big Data
- Differentiate between traditional data processing systems and Big Data technologies
- Apply Hadoop ecosystem tools for distributed data storage and processing
- Perform basic operations using NoSQL databases like MongoDB
- Analyze large datasets using appropriate Big Data tools and techniques

UNIT I

Introduction To Big Data And Analytics: Classification of Digital Data, Structured and Unstructured Data - Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics important - Top Analytics Tools.

UNIT II

Introduction To Technology Landscape: NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem

UNIT III

Introduction to Mongoddb And Mapreduce Programming: MongoDB: Why Mongo DB - Terms used in RDBMS and Mongo DB - Data Types - MongoDB Query Language. MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

UNIT IV

Introduction to Hive: Hive: Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins – Aggregations - Group by and Having - RCFile Implementation - Hive User Defined Function - Serialization and Deserialization.

Suggested Text Books:

1. Big Data Analytics by Seema Acharya and Subhashini Chellappan (Wiley India)
2. Hadoop: The Definitive Guide by Tom White (O'Reilly)
3. MongoDB: The Definitive Guide by Kristina Chodorow (O'Reilly)
4. Programming Hive by Edward Capriolo, Dean Wampler, and Jason Rutherglen

DSE304: BIG DATA ANALYSIS PRACTICALS:

1. Data Classification Exercise: Collect 5 different types of files (e.g., a CSV file, an image, a tweet, a log file, and a SQL table) and classify them into Structured, Semi-Structured, or Unstructured Data.
2. Hadoop Environment Setup: Perform the installation and configuration of a Single Node Hadoop Cluster (Pseudo-distributed mode) and verify the installation using the jps command.
3. HDFS File Operations: Practice basic Hadoop Distributed File System commands such as creating directories (mkdir), uploading files (put), downloading files (get), and listing files (ls).
4. NoSQL vs. SQL Comparison: Create a simple student record table in a Relational Database (like MySQL) and a corresponding Document in a NoSQL Database (MongoDB) to observe the difference in schema flexibility.
5. MongoDB Basic CRUD Operations: Perform the basic "Create, Read, Update, and Delete" operations in MongoDB using the MongoDB Query Language (MQL).
6. MapReduce Logic - Word Count: Write and execute a simple MapReduce program (using Java or Python) to count the frequency of each word in a large text file.

7. MapReduce Advanced - Sorting: Implement a MapReduce job to perform Searching and Sorting on a dataset (e.g., sorting employee records by salary).
8. Hive Table Management: Create a Managed Table and an External Table in Apache Hive, and load data from a local CSV file into these tables.
9. Hive Data Partitioning: Implement Partitions and Bucketing in Hive to demonstrate how they improve query performance when dealing with large datasets.
10. Hive Joins and Aggregations: Execute complex Hive Query Language (HQL) statements involving Joins, Group By, and Having clauses to analyze data stored in the Hadoop ecosystem.

DSE305: EXPLORATORY DATA ANALYSIS

Course Objectives

The primary goals of this course are:

- To instill an "EDA-first" mindset, emphasizing the importance of understanding data quality and patterns before applying complex models.
- To master the techniques of Data Cleaning, including the systematic handling of missing values, outliers, and duplicates.
- To provide a deep understanding of statistical measures for central tendency, spread, and the overall shape of data distributions.
- To develop proficiency in Visual Analytics, teaching students to select and interpret the most effective charts for univariate, bivariate, and multivariate relationships.

Course Outcomes

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

- Classify data types (Nominal, Ordinal, Discrete, and Continuous) and apply the appropriate "Tidy Data" principles for analysis.
- Clean and Preprocess raw datasets by implementing logical strategies for imputation, outlier treatment, and feature engineering.
- Perform Univariate Analysis to describe the "identity" of a single variable using summary statistics and distribution plots.
- Analyze Relationships between multiple variables using correlation coefficients, heatmaps, and scatter plots to identify hidden patterns or dependencies and Evaluate Data Distribution

Unit 1: Introduction to EDA & Data Preparation

The EDA Philosophy: What is EDA? Difference between Descriptive and Inferential statistics. Why we explore data before modeling. Data Types & Structures: Understanding Categorical (Nominal/Ordinal) and Numerical (Discrete/Continuous) data. Data Cleaning Basics: * Handling missing values (Imputation vs. Deletion), Identifying and treating outliers, Removing duplicate records. Tools of the Trade: Introduction to the "Tidy Data" concept.

Unit 2: Univariate Analysis (Exploring One Variable)

Summary Statistics: Understanding Central Tendency (Mean, Median, Mode) and Spread (Range, Variance, Standard Deviation). Shape of Data: Skewness and Kurtosis. Understanding the "Normal

Distribution." Visualizing Single Variables: Histograms: To see frequency and distribution, Box Plots: To identify quartiles and outliers, Bar Charts: For categorical frequency.

Unit 3: Bivariate & Multivariate Analysis (Finding Relationships)

Numerical vs. Numerical: Scatter Plots: Visualizing the relationship between two numbers, Correlation: Understanding Pearson's r (Strength and Direction of relationship). Categorical vs. Numerical: Grouped Summary Statistics: Comparing means across different groups, Segmented Box Plots: Identifying differences in distribution between categories. Multivariate Discovery: Using Heatmaps and Pair Plots to find patterns across multiple variables simultaneously.

Unit 4: Insights, Visual Storytelling & Ethics

The Power of Visualization: Choosing the right chart for the right data (Comparison vs. Relationship vs. Composition). Feature Engineering: Creating new variables from existing ones (e.g., extracting "Year" from a "Date" column). The "Lie" of Statistics: How visuals can be misleading (scaling issues, cherry-picking data). Reporting Findings: Moving from raw charts to actionable insights and business stories.

DSE305: EXPLORATORY DATA ANALYSIS PRACTICALS:

1. Missing Value Audit: Take a messy dataset and calculate the percentage of missing values per column.
2. Outlier Detection: Use a Box Plot to find the "extreme" values in a dataset of house prices.
3. The Histogram Challenge: Plot the ages of a population and determine if the distribution is "Skewed Right" or "Skewed Left."
4. Variable Comparison: Use a Scatter Plot to see if "Time Spent Studying" correlates with "Exam Scores."
5. Pivot Table Magic: Create a summary table showing the average sales per city.
6. Correlation Heatmap: Generate a heatmap to find which two features in a car dataset are most closely linked (e.g., Horsepower vs. Fuel Efficiency).
7. Categorical Breakdown: Use a Bar Chart to visualize the most popular programming languages among students.
8. Data Transformation: Convert a "Birthdate" column into an "Age" column and re-analyze the distribution.
9. Standardization: Apply Min-Max scaling to a column to see how the data range changes.
10. Final Storyboard: Take a small dataset (like the Titanic or Iris dataset) and create 3 charts that tell a complete story.

Suggested Textbooks:

1. Exploratory Data Analysis by John Tukey (The original founder of the field).
2. Python for Data Analysis by Wes McKinney.
3. Storytelling with Data by Cole Nussbaumer Knafllic (Excellent for Unit 4).

AEC301: SOFT SKILLS

Course Objectives:

- To understand the concept, process, and importance of Business Communication.

- To help students in understanding the basic principles and techniques of business communication.
- To train students to acquire and master written communication for the corporate world.
- To sensitize students to understand Business Communication in Global and Cross-Cultural context.

Course Outcomes

Students will be able to:

- Communicate effectively in professional settings
- Write formal business documents
- Demonstrate interpersonal and presentation skills
- Use digital communication tools responsibly

Unit 1: Introduction to Communication in Organizations

Introduction to Business Environment and Communication, Models of communication, Basics of Communication (types, channels and barriers), 7Cs of communication, Formal and informal communication, Listening Skills, communication on social media platforms.

Unit 2: Written Communication

Planning and executing different types of messages, emails, formal letters (Planning & Layout of Business Letter) and informal messages on e-platforms, negative messages: indirect & direct negative messages; Persuasive messages, request letters to various stakeholders, Sales Letters, Complaint & Follow up Letters, Promotion Letters, Job application Letters, cover letters, resume, Resignation Letters.

Unit 3 - Interpersonal Communication

Team communication, managing communication during online meeting, communication with virtual team, communication in gig economy; Presentation skills (Verbal and non-verbal); Powerpoint presentation skills; Infographics, introduction to contemporary alternatives (such as- Prezi, Visme, Microsoft Sway, Zoho)

Unit 4 - Digital Communication

Social media and individual, social media & organizations, Media Literacy; Strong Digital communication skills – email, instant messaging, video conferencing, e-meetings, Digital collaboration, digital citizenship –digital etiquettes & responsibilities; introduction to personal and organizational websites.

Recommended Books:

1. AICTE's Prescribed – Communication Skills in English, Khanna Book Publishing.
2. Lesikar, R.V. & M.E. Flatley, "Business Communication: Connecting in a Digital World", McGraw-Hill Education.
3. Murphy, H. A., Hildebrandt, H. & Thomas, J.P., Effective Business Communication. McGraw Hill.
4. Mukerjee H. S., Business Communication: Connecting at Work. Oxford Publication
5. Boove, C.L., Thill, J. V. & Raina, R. L, Business Communication Today, Pearson.