Curriculum for UG Degree in Bachelor in Computer Applications BCA/BCA (Honours)/ BCA (Honours with Research) and Specialization in (AI & ML) and Data Science

(Based on AICTE Curriculum and Credit Framework for BCA Program and Formative Assessment Guidelines under NEP-2020)

With Effect From the session 2025-26

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

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

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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:

a. **One year:** Under Graduate Certificate in Computer Application
b. **Two years**: Under Graduate Diploma in Computer Application
c. **Three years**: Bachelor in Computer Application (BCA)
d. **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:

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

2. **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.*

Semester wise Structure and Curriculum for UG Course in BCA

SEMESTER I

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)							
1	CC101	25BCA401DS01	Mathematics Foundations to Computer Science - I	3	0	0	3
2	SEC101	25BCA401SEC01	Problem Solving Techniques	3	0	4	5
3	CC102	25BCA401DS02	Computer Architecture	3	0	4	5
4	AEC101	25ENGX01AE01	General English - I	1	1	0	2
5	MDE101	25SOCX01MD01	Indian Knowledge System	2	0	0	2
6	VAC101	25CSAX01VA01	Environmental Science and sustainability	2	0	0	2
7	AEC102	25HNDX01AE01 or 25SKTX01AE01	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1- 0)) [optional course]*	1	1	0	0*
			TOTAL				**19**

Note:
L T P shown in all the tables of the scheme against the courses are w.r.t. the Workload for the semester.
^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	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC103	25BCA402DS01	Mathematics Foundations to Computer Science - II	3	0	0	3
2	CC104	25BCA402DS02	Data Structures	3	0	4	5
3	CC105	25BCA402DS03	Operating Systems	3	0	2	4
4	SEC102	25BCA402SEC01	Object Oriented Programming using Java	3	0	4	5
5	SEC103	25BCA402SEC02	Web Technologies	1	0	2	2
6	VAC102	25EVSX01AC01	Indian Constitution	2	0	0	2
7	AEC103	25HNDX03AE01 or 25SKTX03AE01	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.

SEMESTER III

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC201	26BCA403DS01	Probability and Statistics	3	0	0	3
2	CC202	26BCA403DS02	Data Base Management System	3	0	4	5
3	SEC201	26BCA403SEC01	Python Programming	2	0	4	4
4	CC203	26BCA403DS03	Software Engineering	3	0	0	3
5	CC204	26BCA403DS04	Computer Graphics	2	0	2	3
6	VAC201	26Y0GXO4VA01/ 26SPOXO4VA02/ 26NCCXO4VA03/ 26NSSXO4VA04/ 26DMTXO4VA05	Yoga/ Sports/ NCC/ NSS/ Disaster Management	0	0	4	2
			TOTAL				**20**

SEMESTER IV

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC204	26BCA404DS01	Entrepreneurship and Startup Ecosystem	1	1	0	2
2	CC205	26BCA404DS02	Computer Networks	3	0	4	5
3	CC206	26BCA404DS03	Design and Analysis of Algorithm	3	0	0	3
4	CC207	26BCA404DS04	Artificial Intelligence	3	0	4	5
5	CC208	26BCA404DS05	Advanced Database Systems	2	0	2	3
6	SEC202	26BCA404SEC01	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.

SUMMATIVE ASSESSMENT

For Core Courses and Discipline Specific Elective Courses

For three credits of theory and two credit of practical (3:0:2)

		Marks Distribution
Theory	Internal	25
	External	50
Practical		50
Total		125

For three credits of theory and one credit of practical (3:0:1)

		Marks Distribution
Theory	Internal	25
	External	50
Practical		25
Total		100

For three credits of theory (3:0:0)

		Marks Distribution
Theory	Internal	25
	External	50
Practical		0
Total		75

For two credits of theory and two credits of tutorial (2:2:0)

		Marks Distribution
Theory	Internal	50
	External	50
Practical		0
Total		100

For two credits of theory and two credits of practical (2:0:2)

		Marks Distribution
Theory	Internal	15
	External	35
Practical		50
Total		100

For two credits of tutorial and two credits of practical (0:2:2)

		Marks Distribution
Theory	Internal	50
	External	0
Practical		50
Total		100

For one credit of theory and one credit of tutorial (2:0:0)

		Marks Distribution
Theory	Internal	15
	External	35
Practical		0
Total		50

For one credit of theory and two credit of practical (1:0:2)

		Marks Distribution
Theory	Internal	5
	External	20
Practical		50
Total		75

For one credit of theory and one credit of tutorial (1:1:0)

		Marks Distribution
Theory	Internal	25
	External	25
Practical		0
Total		50

Evaluation Scheme for Practical/Lab Examination: 25 Marks

		Marks Distribution
Program 1	Flowchart/Algorithm	01
	Writing Program	01
	Execution and Program Format	02
Program 2	Flowchart/Algorithm	01
	Writing Program	01
	Execution and Program Format	02
Viva Voce		07
Practical File*		05
Attendance*		05
Total		25

***: Marks to be provided by the Internal Teacher**

Evaluation Scheme for Practical/Lab Examination: 50 Marks

		Marks Distribution
Program 1	Flowchart/Algorithm	02
	Writing Program	03
	Execution and Program Format	05
Program 2	Flowchart/Algorithm	02
	Writing Program	03
	Execution and Program Format	05
Viva Voce		20
Practical File*		05

Attendance*	05
Total	50

***: Marks to be provided by the Internal Teacher**

FORMATIVE ASSESSMENT

Formative Assessment Model
For Value Added Course

For two credits theory (2:0:0)

	Marks distribution
Written test (2 X 10)	20
Class assignments / Case study / Mini project (2 X 5)	10
Quiz / seminar / Group discussion / Debate / QM profile (2 X 7.5)	15
Attendance	05
Total	**50**

For two credits practical (0:0:2)

	Marks distribution
Regular assessment through observation and class discussion	20
Field work (Report)/Mini project	15
Assignment (2 X 5)	10
Attendance	05
Total	**50**

Formative Assessment Models
For Multidisciplinary Course

For three credits theory (3:0:0)

	Marks distribution
Written test (2 X 10)	20
Class assignments / Case study / Mini project (2 X 10)	20
Book review / Essay / Seminar (1 X 10)	10
Quiz / Group discussion / Debate (2 X 10)	20
Attendance	05
Total	**75**

For two credits theory and one credit practical (2:0:1)

	Marks distribution
Written test (2 X 10)	20
Lab work (practical file) / Field work (report)/Portfolio	20
Assignment/Case study / Mini project (2 X 10)	20
Seminar / Presentation	10
Attendance	05
Total	**75**

For three credits practical (0:0:3)

	Marks distribution
Regular assessment through observation and class discussion	10
Lab work (practical file) / field work (report)/Portfolio	30
Assignment/Case study / Mini project (2 X 10)	20
Seminar / Presentation	10
Attendance	05
Total	**75**

For two credits theory (2:0:0)

	Marks distribution
Written test (2 X 10)	20
Class assignments / Case study / Mini project (2 X 5)	10
Quiz / seminar / Group discussion / Debate / QM profile (2 X 7.5)	15
Attendance	05
Total	**50**

Internship Evaluation by Formative Assessment

After completing the internship, students must prepare a comprehensive report highlighting their learning and takeaways during the internship period as per the **MDU Internship Regulations 2025**. The report shall be signed by the Internship Supervisor from the respective UTD/Centre/College and Mentor from the internship-providing organizations. Internship Supervisor and Mentor will jointly conduct evaluation of internship report and viva-voce on the time and date notified by the concerned HoDs/Directors/Principals. The mentor from the host organization may participate in the evaluation through online/offline mode. In case the respective mentor is unavailable, the relevant mentor, as decided by the concerned HOD/Director/Principal, may be utilized for evaluation.

Suggested distribution of marks is as follows:
Credit 0:0:4

<table>
<tr><th>S. No.</th><th>Components</th><th>Employability-Oriented Internship</th><th>Research-Oriented Internship</th></tr>
<tr><td>1</td><td>Assessment by Mentor
<table>
<tr><th>S. No</th><th>Details</th><th>Marks</th></tr>
<tr><td>1</td><td>Skills learned</td><td>15</td></tr>
<tr><td>2</td><td>Regularity</td><td>10</td></tr>
<tr><td>3</td><td>Conduct</td><td>5</td></tr>
<tr><td></td><td>Total(30)</td><td></td></tr>
</table></td><td>30</td><td>30</td></tr>
<tr><td>2</td><td>Internship Report</td><td>40</td><td>40</td></tr>
<tr><td>3</td><td>Viva-Voce</td><td>30</td><td>30</td></tr>
<tr><td></td><td>Total</td><td>100</td><td>100</td></tr>
</table>

Evaluation of Project Report / Dissertation

Regarding project reports/dissertations/research projects, internal and external examiners shall jointly carry out the assessment. There shall be no Internal assessment component for the Dissertation / Project Report. External examiners shall be invited from amongst the panel of examiners (ordinarily not below the rank of Associate Professor) recommended by the concerned Board of Studies.

Credit 0:0:20

Total marks for Project Report/Dissertation as per MDU/AICTE: 500

Note: -

1. From the Academic session 2026 – 2027, the pattern of Skill Enhancement Courses will be revised as follows, wherever applicable:

For Four Credit SEC	For Three Credit SEC	For Two Credit SEC
L – T – P	L – T – P	L – T – P
0 – 0 – 4	0 – 0 – 3	0 – 0 – 2
1 – 0 – 3	1 – 0 – 2	----
2 – 0 – 2	---	----

2. The details of Formative Assessment in hard copy shall be submitted to the Controller of Examinations within a week of uploading the marks on the portal and the relevant records along with the documents based on which the marks have been awarded, and shall be maintained for a minimum period of two years in the Department/Centre/Institute/ affiliated colleges. The records may be verified/summoned by the Controller of Examinations.

Syllabus for
4-Year Bachelor Program in Computer Applications
[Leading to BCA and BCA(Honours)/BCA(Honours) with Research Degrees]

w.e.f.

Academic Session 2025-26

SEMESTER-I

CC101	**25BCA401DS01**	**Mathematics Foundations to Computer Science - I**	**3L:0T:0P**	**3 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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 mathematical principles give a succinct abstraction of computer science problems and help them to analyze them efficiently.

Unit – I

Set, Relation and Function: Set, Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian ProductsRelations 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.

Suggested Readings:

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company
3. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education
4. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India
5. Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan
6. Grimaldi Ralph P. and Ramana B. V., Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education
7. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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SEC101	25BCA401SEC01	Problem Solving Techniques	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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

CO4: Translate an algorithm into a C computer program (Create)

CO5: Testing and analysing programs using debugging tools. (Analyze)

Unit – I

Problems And Problem Instances, Generalization and Special Cases, Types of ComputationalProblems, 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

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

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 SentinelControlled Repetition using only a few Variables.

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

Unit – IV

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.

Suggested Readings:

1. Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company.

2. Gill Nasib Singh, "Handbook of Computer Fundamentals", ISBN: 978-93-82609674 Khanna Book Publishing Co.(P) Ltd, New Delhi.

3. Gill Nasib Singh, "Computing Fundamentals and Programming in C", ISBN: 978-93-81068-50-2 Pages: 832 Khanna Book Publishing Co.(P) Ltd, New Delhi.

4. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company

5. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India

6. R G Dromey, How to Solve It by Computer.

7. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson.

8. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson.

Note: Latest and additional good books may be suggested and added from time to time.

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 (>= 0) display number, square and cube of numbers from 1 to n in a tabular format?
4. Given an input positive integer number, display odd numbers from in the range [1,n]?
5. Display first mathematical tables, each table up to 10 rows? Generalise this to display first n (> 0) mathematical tables up to m (m > 0) rows?
6. Display following patterns of n rows (n > 0), For the below examples n = 5? For each pattern write a separate algorithm/program?

$ $$ $$$ $$$$ $$$$$	$ $$ $$$ $$$$ $$$$$	12345 1234 123 12 1	12345 1234 123 12 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 n1 and n2 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 ≤ marks ≤ 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 <= input Base, outputBase<= 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, BMI = weightinKGs / (HeightinMeters *HeightinMeters), Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges:
    BMI Values
    Underweight: less than 18.5
    Normal: >=18.5 and <25
    Overweight: >=25 and < 30
    Obese: >= 30

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?

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CC102	25BCA401DS02	Computer Architecture	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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, Excess3 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, InputOutput 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.

Suggested Readings:

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.
3. Gill, Nasib Singh and Dixit J. B., "Digital Design and Computer Organisation", 978-81-318-0345-5 Pages: 396 University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.)
4. William Stallings- "Computer Organization and Architecture", Pearson/PHI, Sixth Edition,
5. Andrew S. Tanenbaum- "Structured Computer Organization", PHI /Pearson 4th Edition,
6. M.V .Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.
7 Ikvinderpal Singh, Computer Organization Architecture, Khanna Book Publishing.

Note: Latest and additional good books may be suggested and added from time to time.

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.

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AEC 101	25ENGX01AE01	General English – I	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objective:

CO1: To provide learning environment to practice listening, speaking, reading and writing skills.
CO2: To assist the students to carry on the tasks and activities through guided instructions and materials.
CO3: To effectively integrate English language learning with employability skills and training.
CO4: To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Unit – I

Vocabulary Building and Basic Writing Skills

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.

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

Unit – II

Identifying Common Errors in Writing

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

Unit – III

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 – IV

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. Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.
Suggested Readings: 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 Heasly. 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. **Note:** Latest and additional good books may be suggested and added from time to time.

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

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Indian Knowledge System

MDE 101	**25SOCX01MD01**	**Indian Knowledge System**	**2L:0T:0P**	**2 Credits**

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VAC 101	25CSAX01VA01	Environmental Science and Sustainability	2L:0T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objectives:

CO1: This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forthcoming sustainability challenges.

CO2: This course will equip students to make decisions that consider environmental consequences.

CO3: This course will enable future business graduates to become environmentally sensitive and responsible managers.

Unit – I

Understanding Environment, Natural Resources, and Sustainability

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

Unit – II

Ecosystems, Biodiversity, and Sustainable Practices

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

Unit – III

Environmental Pollution, Waste Management, and Sustainable Development

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

Unit – IV

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.

Suggested Readings:

1. Poonia, M.P. *Environmental Studies* (3rd ed.), Khanna Book Publishing Co.
2. Bharucha, E. *Textbook of Environmental Studies* (3rd ed.) Orient Blackswan Private Ltd.
3. Dave, D., &Katewa, S. S. *Text Book of Environmental Studies.* Cengage Learning India Pvt Ltd.
4. Rajagopalan, R. *Environmental studies: from crisis to cure* (4th ed.). Oxford University Press.
5. Miller, G.T. &Spoolman S. *Living in the Environment*. (20th ed.). Cengage.

6. Basu, M., & Xavier Savarimuthu, S. J. *Fundamentals of environmental studies*. Cambridge University Press.
7. Roy, M. G. *Sustainable Development: Environment, Energy and Water Resources*. Ane Books.
8. Pritwani, K. *Sustainability of business in the context of environmental management.* CRC Press.
9. Wright, R.T. & Boorse, D.F. *Environmental Science: Toward A Sustainable Future* (13th ed,). Pearson.

Web links:

https://www.ourplanet.com

https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

www.myfootprint.org

https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem /ecosystem.html

SEMESTER –II

CC103	25BCA402DS01	Mathematics Foundation to Computer Science - II	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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 Onlyformula 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.

Suggested Readings:

1. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education.
2. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL.
3. Taha Hamdy A., Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall.
4. S.B. Singh, Discrete Structures, Khanna Book Publishing, (AICTE Recommended Textbook)
5. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India
6. Chakravorty J. G. and Ghosh P. R., Linear Programming and Game Theory, Moulik Library.
7. Sharma J. K., Operations Research: Theory and Applications, Fourth Edition, Macmilllan Publishers.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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CC104	25BCA402DS02	Data Structures	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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 TwoDimensional 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.

Suggested Readings:

1. R.B. Patel, “Expert Data Structures with C”, Khanna Book Publishing Company (AICTE Recommended Textbook)
2. Seymour Lipschutz, “Data Structures with C”, Schaum’s Outlines, Tata McGraw-Hill.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications.
4. Reema Thareja, “Data Structures Using C", Second Edition, Oxford University Press.
5. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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.

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CC105	25BCA402DS03	Operating Systems	3L:0T:2P	4 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

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.

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.

Suggested Readings:

1. Ekta Walia, Operating Systems Concepts, Khanna Publishing House, (AICTE Recommended Textbook)
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne , Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.
3. Stallings Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.
4. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.
5. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

Note: Latest and additional good books may be suggested and added from time to time.

Operating Systems LAB

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.

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SEC102	25BCA402SEC01	Object Oriented Programming using Java	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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

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.

Unit – II

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

Operators & Expressions: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity.

Decision Making, Branching & Looping: Decision Making with Control Statements, Looping statements, Jump in loops, Labelled loops.

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.
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
Suggested Readings: 1. Balaguruswamy E. Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education 2. Schildt, H. Java: The Complete Reference. 12th edition. McGraw-Hill Education. 3. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited. 4. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited. 5. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson. 6. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press. **Web Resources** a https://www.w3schools.com/java/. b http://www.java2s.com/. c https://onlinecourses.nptel.ac.in/noc22_cs47/preview **Note:** Latest and additional good books may be suggested and added from time to time.
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 command line arguments. 3. Write a program to send the name and surname of a student through command line arguments and print a welcome message for the student. 4. Write a java program to find the largest number out of n natural numbers. 5. Write a java program to find the Fibonacci series & Factorial of a number using recursive and non recursive functions. 6. Write a java program to multiply two given matrices. 7. Write a Java program for sorting a given list of names in ascending order. 8. Write a Java program that checks whether a given string is a palindrome or not .Ex:MADAM is a palindrome. 9. Write a java program to read n number of values in an array and display it in reverse order. 10. Write a Java program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations. 11. Create a JAVA class called Student with the following details as variables within it. a. USN, NAME, BRANCH, PHONE, PERCENTAGE b. Write a JAVA program to create n Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable headings. 12. Write a Java program that displays the number of characters, lines and words in a text.

13. Write a Java program to create a class called Shape with methods called getPerimeter() and getArea(). Create a subclass called Circle that overrides the getPerimeter() and getArea() methods to calculate the area and perimeter of a circle.
14. Write a Java program to create a class Employee with a method called calculateSalary(). Create two subclasses Manager and Programmer. In each subclass, override the calculateSalary() method to calculate and return the salary based on their specific roles.
15. Write a Java program using an interface called 'Bank' having function 'rate_of_interest()'. Implement this interface to create two separate bank classes 'SBI' and 'PNB' to print different rates of interest. Include additionalm ember variables, constructors also in classes 'SBI' and 'PNB'.
16. Write a Java package program for the class book and then import the data from the package and display the result.
17. Write a Java program for finding the cube of a number using a package for various data types and then import it in another class and display the results.
18. Write a Java program for demonstrating the divide by zero exception handling.
19. Write a Java program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
20. Create an exception subclass UnderAge, which prints "Under Age" along with the age value when an object of UnderAge class is printed in the catch statement. Write a class exceptionDemo in which the method test() throws UnderAge exception if the variable age passed to it as argument is less than 18. Write main() method also to show working of the program.

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SEC103	25BCA402SEC02	Web Technologies	1L:0T:2P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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 side and server side Internet Programming and basic full stack web development.

CO4:To develop modern interactive web applications

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.

Unit – II

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 – III

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

Unit – IV

Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.

Introduction to AJAX, Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX.

Introduction to XML: uses, Key concepts, DTD 8 schemas, XSL, XSLT,and XSL Elements and transforming with XSLT. Introduction to XHTML.

JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects

Suggested Readings:

1. Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications
2. Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition
3. Silvio Moreto, Bootstrap 4 By Example, ebook.
4. 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/

Note: Latest and additional good books may be suggested and added from time to time.

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 andexternal) toformat 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 addiction, subtraction, multiplication and division operation using JavaScript.
3) Use Regular Expressions for validations in Login Page using JavaScript.
4) Write a Program to retrieve date 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.

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VAC102	25EVSX01AC01	Indian Constitution	2L:0T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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

CO1: Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure.
CO2: Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha).
CO3: State Government Mechanisms: Examine the powers of the Governor, Chief Minister, and the State Secretariat.
CO4: Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats.
CO5: Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections.

Unit – I

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

Unit – II

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

Unit – III

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

Unit – IV

Local Administration and Election Commission
- District Administration

- Municipal Corporation
- Zila Panchayat
- Election Commission: Role and Functioning, Chief Election Commissioner, State Election Commission

Suggested Readings:

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

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/

Note: Latest and additional good books may be suggested and added from time to time.

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SEMESTER –III

CC201	26BCA403DS01	Probability and Statistics	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: To make the students trained to handle randomness scientifically using theory of probability.

CO2: 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.

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**.

Suggested Readings:

1. Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, (AICTE Recommended Textbook)
2. Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill.
3. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier.
4. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Edu
5. Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI.
6. Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley.
7. Reena Garg, Engineering Mathematics, Khanna Publishing House.

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CC202	26BCA403DS02	Database Management Systems	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1:Understanding Core Concepts of DBMS

CO2:Proficiency in Database Design and SQL

CO3:Application of Advanced Database Techniques

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

Suggested Readings:

1. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, third edition, McGraw – Hill.
2. Benjamin Rosenzweig, Elena Rakhimov, “Oracle PL/SQL by Example”, fifth edition, Prentice

Hall
3. Brad Dayley, “NoSQL with MongoDB in 24 Hours”, 1st edition, Sams Publishing.
4. Korth, Silbertz, Sudarshan,” Database System Concepts”, Seventh Edition, McGraw - Hill
5R.P. Mahapatra, Govind Verma, “Database Management Systems”, Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

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

1. Create the above tables
2. Add a new attribute state in supplier table
3. Remove attribute city from supplier table
4. Modify the data type of phone attribute
5. Change the name of attribute city to address
6. Change a table’s name, supplier to sup
7. Use truncate to delete the contents of supplies table
8. 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 SavePoints3.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

Perform Inner, Natural, Left order and Right order join on two 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

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 a 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.

***Any other programs assigned by the teachers.**

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SEC201	26BCA403SEC01	Python Programming	2L:0T:4P	4 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry

equal marks.

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.

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.

Unit – II

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

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.

Unit – III

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

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

Unit – IV

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

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

Suggested Readings:

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

1. Think Python, by Allen Downey, 2nd edition,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, 2 ndedition, PHI India.

Note: Latest and additional good books may be suggested and added from time to time.

List of Practicals

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) witht1.
   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.

***Any other programs assigned by the teachers.**

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CC203	26BCA403DS03	Software Engineering	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all

by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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 decisionmaking for successful software project execution.

CO3:To Master the art of software design, development, and testing to produce robust and efficient software solutions.

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.

Suggested Readings:

1. Nasib Singh Gill, Software Engineering, Khanna Publishing House,(AICTE Recommended Textbook)
2. Ian Somerville, Software Engineering, 9th edition, Pearson education.
3. Roger S Pressman, Bruce R. Maxim., Software Engineering A practitioner's Approach, 8th edition, McGraw Hill Education.
4. Stephen Schach, Software Engineering 7th ed, McGraw-Hill.
5. Hans van Vliet ,Software Engineering: Principles and Practice

Note: Latest and additional good books may be suggested and added from time to time.

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CC204	26BCA403DS04	Computer Graphics	2L:0T:2P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all

by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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 decisionmaking for successful software project execution.

CO3:To Master the art of software design, development, and testing to produce robust and efficient software solutions.

Unit – I

Introduction to Computer Graphics: Overview of computer graphics and its applications, Historical development, Application areas. Basics of raster and vector graphics, Difference between raster and vector graphics.

Graphics primitives: Coordinate systems, types of primitives (points, lines, polygons), Cartesian and homogeneous coordinate systems, transformation matrices and their applications

Unit – II

2D Graphics Programming: Pixel operations and drawing algorithms, color models (RGB, CMYK, HSL). Line drawing algorithms (Digital differential analyzer algorithm, Bresenham's line drawing algorithm), Circle drawing algorithms (Midpoint circle algorithm, Bresenham's circle drawing algorithm).

2D Transformations: Translation, Rotation, Scaling, mirror reflection. Basic and advance problems involving composite operations.

Unit – III

Windowing techniques: Basic terminologies-Window, Viewport, Clipping window, Region codes.

Clipping techniques: Point clipping, Line clipping (midpoint subdivision method, Cohen-Sutherland line clipping algorithm), Polygon clipping (Sutherland-Hodgeman polygon clipping algorithm).

Unit – IV

3D Graphics Programming: 3D transformations, Translation, Rotation, Scaling. Homogeneous coordinates and transformations. **Projection techniques**: Orthographic projection, Perspective projection and Vanishing points

Suggested Readings:

1. D. Hearn and M. P. Baker: Computer Graphics with OpenGL, Pearson.
2. J. F. Hughes, A. van Dam, M. McGuire, D. F. Sklar, and J. D. Foley: Computer Graphics: Principles and Practice, Addison-Wesley.
3. D. Shreiner, G. Sellers, J. M. Kessenich, and B. M. Licea-Kane: OpenGL Programming Guide: The Official Guide to Learning OpenGL, Addison-Wesley.
4. E. Angel and D. Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, Addison-Wesley.
5. F. Klawonn: Introduction to Computer Graphics: Using Java 2D and 3D, Springer.
6. Any other book covering the contents of the subject.

Note: Latest and additional good books may be suggested and added from time to time.

List of Programs

1. Write a program to define and use basic graphics primitives such as points, lines, and polygons.
2. Write a program to draw a line using the Digital Differential Analyzer (DDA) algorithm.
3. Write a program to draw a line using Bresenham's line drawing algorithm.
4. Write a program to draw a circle using the Midpoint Circle algorithm.
5. Draw a circle using Bresenham's circle drawing algorithm.
6. Write a program to perform 2D transformations: translation, rotation, and scaling on a given set of points.
7. Write a program to perform mirror reflection of a 2D shape across the x-axis and y-axis.
8. Program to draw basic two-dimensional objects like rectangles, triangles, and polygons using inbuilt functions
9. Write a program to apply various coloring techniques on 2D pictures.

10. Write a program to implement line clipping using the Cohen-Sutherland line clipping algorithm.
11. Write a program to perform 3D transformations: translation, rotation, and scaling on a set of 3D points.
12. Implement a program to demonstrate simple animations using transformations such as translation, rotation, and scaling.
13. Write a program to apply various coloring techniques on given three dimensional object.

***Any other programs assigned by the teachers.**

VAC201	26YOGX04VA01	Yoga and Physical fitness	0L:0T:4P	2 Credits

Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

YOGA

Course Objective(s):

CO1: Understand yoga's significance and its practical applications for holistic well-being.

CO2: Explore subtle energy systems and their role in enhancing health through yogic practices.

CO3: Examine various paths of yoga to foster self-realization and spiritual growth.

CO4: Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.

CO5: Apply yogic principles to manage psycho-somatic ailments and promote resilience.

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 yaga, 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, dhyan, 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

Suggested Readings:

- 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).

VAC201	26SPOX04VA02	Sports Management	0L:0T:4P	2 Credits

SPORTS MANAGEMENT

Course Objective(s):

CO1: Understand the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations.

CO2:Analyse the role of marketing and sponsorship in the sports industry, with a focus on branding, target audience segmentation, and event management.

CO3: Develop proficiency in financial management techniques specific to the sports industry, including revenue generation, cost management, and investment strategies.

CO4: Explore the application of analytics and technology in sports, including performance evaluation, strategic decision-making, and fan engagement.

CO5: Apply theoretical knowledge to practical scenarios through case studies and projects, fostering critical thinking and problem-solving skills in sports management contexts.

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 modelling, Key performance indicators (KPIs) in sports, Applications of analytics: talent scouting, injury prevention, performance optimization.

Suggested Readings :

1. Pedersen, P. M., Thibault, L., & Pedersen, P. M. Contemporary Sport Management. Human Kinetics.
2. Hoye, R., Smith, A. C. T., Nicholson, M., et al., Sports Management: Principles and Applications. Routledge.
3. Chelladurai, P., & Kerwin, S. Introduction to Sport Management: Theory and Practice. Human Kinetics.

4 Conrad, M. The Business of Sports: A Primer for Journalists. Routledge.
5 Shank, M. D. Sports Marketing: A Strategic Perspective. Pearson.
6 Fullerton, S. Jr., & Funk, D. C. Sports Marketing: A Practical Approach. Routledge.
7 Conrad, M. Winning in Sports Business: Essential Marketing, Finance, and Management Strategies. Routledge.
8 McCarty, L. A., & McPherson, G. Sports Event Management: The Caribbean Experience. Routledge.
9 Brown, M. T., Rascher, D., & Leeds, M. A. Financial Management in the Sport Industry. Routledge.

VAC201	26NCCX04VA03	NCC	0L:0T:4P	2 Credits

NATIONAL CADET CORPS (NCC)

Course Objective(s):

CO1: Understand the foundational role of drill in fostering discipline and leadership within a group, enabling effective command towards achieving common goals.

CO2: Appreciate the importance of grace and dignity in executing foot drill movements, recognizing their significance in enhancing performance and teamwork.

CO3: Comprehend the criticality of weapon handling and detailed safety measures, emphasizing the importance of accident prevention through strict adherence to safety protocols.

CO4: 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.

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

Suggested Readings:

1. DGNCC Cadet's Hand Book - Common Subjects -All Wings
2. Tiwari, R. NCC: Grooming Feeling of National Integration, Leadership and Discipline among Youth. Edwin Incorporation.
3. Chhetri, R.S. Grooming Tomorrows Leaders, The National Cadet Corps.
4. Directorate General National Cadet Corps. National Cadet Corps, Youth in Action.
5. Vanshpal, Ravi. The NCC Days, Notion Press.

VAC201 26NSSX04VA04 NATIONAL SERVICE SCHEME (NSS) 0L:0T:4P 02 Credits

NATIONAL SERVICE SCHEME (NSS)

Course Objective(s):

CO1: To provide students with an understanding of the history, philosophy, and basic concepts of the National Service Scheme (NSS).

CO2: To familiarize students with the aims, objectives, and organizational structure of NSS.

CO3: To equip students with knowledge about NSS programmes, activities, and their relevance.

CO4: To develop an understanding of community mobilization techniques and their importance in NSS activities.

CO5: To cultivate an appreciation for volunteerism, shramdan (voluntary labor), and their role in community development initiatives.

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 Swatch Bharat Abhiyan and Digital India

Suggested Readings:

1. Ministry of Youth Affairs and Sports, Government of India. National Service Scheme (NSS) Manual.
2. Agarwalla, S. NSS and Youth Development. Mahaveer Publications
3. Bhattacharya, P. Stories Of NSS (English Version). Sahityasree.
4. Borah, R. and Borkakoty, B. NSS in Socioeconomic Development. Unika Prakashan.
5. Wondimu, H., & Admas, G. 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.. Extension Education–The Third Dimension Needs and Aspirations of Indian Youth. *Journal of Social Sciences*, *6*(3), 209-214.
7. Mills, S. "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. Mukherji, B. Community Development in India. Orient Longmans.

VAC201 26DMTX04VA05 DISASTER MANAGEMENT 0L:0T:4P 02 Credits

DISASTER MANAGEMENT

Course Objectives:

CO1: To provide understanding of the concepts related to disaster

CO2: To highlight the importance and role of disaster management

CO3: To enhance awareness of institutional processes and management strategies to mitigate the impacts of disasters

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.**

Suggested Readings

1. Sharma, S.C. Disaster Management, Khanna Book Publishing.
2. Clements, B. W., Disasters and Public Health: Planning and Response, Elsevier Inc.
3. Dunkan, K., and Brebbia, C. A., (Eds.) Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK.
4. Singh, R. B. (ed.),Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.
5. Ramkumar, Mu, Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Modh, S., Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.
7. Carter, N., 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., Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.

SEMESTER –IV

CC204	26BCA404DS01	Entrepreneurship and Startup Ecosystem	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: To understand Entrepreneurship and its types

CO2: To understand that not all ideas can be turned into viable business models and estimate business potential of an idea

CO3: To understand different type of finances available and financing methods

CO4: To be able to draft business plans on an identified idea

CO5: To understand the nuances of operating a startup – low budget marketing, stabilizing operations, build a team from scratch and scaling the business

CO6: To know what is a Family Business and how is it different from Entrepreneurship

Unit – I

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 – II

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 – III

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 – IV

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.

Suggested Readings:

1. Startup India Leaning Programby Start Up India available at www.startupindia.gov.in
2. Entrepreneurship, Rajeev Roy, Oxford University Press
3. Entrepreneurship: Successfully Launching New Venturesby R. Duane Ireland Bruce R. Barringer, Pearson Publishing
4. Family Business Management by Rajiv Agarwal, Sage Publishing
5. Mapping the Startup Ecosystem in India, Anish Tiwari ,*Economic& Political Weekly*
6. Indian Family Businesses: Their survival beyond three generations, Ramachandran, K, ISB Working Paper Series

Note: Latest and additional good books may be suggested and added from time to time.

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CC205	26BCA404DS02	Computer Networks	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

Unit – I

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 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: 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 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.

Suggested Readings:

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson.
3. Gill, Nasib Singh, “Essentials of Computer and Network Technology”, ISBN: 81-87522-71-2 Pages: 340 Khanna Book Publishing Co. (P) Ltd, New Delhi.
4. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education.
5. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan

Kaufmann.
6. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House. Mastering PC Hardware & Networking, Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

Lab Programs

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

***Any other Programs/Lab Assignments given by the teachers.**

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CC206	26BCA404DS03	Design and Analysis of Algorithms	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1:To impart to students the understanding of basic algorithm designing paradigms.

CO2:To introduce the basic knowledge on how to analyse an algorithm.

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

Unit – I

Introduction: 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.

Suggested Readings:

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.
3. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd.
4. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson.
5. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston.
6. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education.

Note: Latest and additional good books may be suggested and added from time to time.

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CC207	26BCA404DS04	Artificial Intelligence	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

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

Unit – I

Introduction to Al: Introduction, 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.

Suggested Readings:

1. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, (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 .
4. Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company.
5. Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall
6. Van Hirtum, A. & Kolski, C. Constraint Satisfaction Problems: Algorithms and Applications. Springer

Note: Latest and additional good books may be suggested and added from time to time.

Lab Assignments

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.

***Any other Programs/Lab Assignments given by the teachers.**

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CC208	26BCA404DS05	Advanced Database Systems	2L:0T:2P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1: To introduce the concepts of E-R Model and EER models.

CO2: Explore the concepts related to object-oriented and object-relational database systems.

CO3: Understand the working of parallel, and distributed database systems.

CO4: Explore Client/Server & Server architectures and how to retrieve information.

CO5: Analyze modern database applications, including Active, Temporal, spatial, multimedia, and XML-based databases etc.

Unit – I

EER Model: Prerequisite of Entity-Relationship Model: Entity Types, Entity Sets, Attributes & Keys, Relationship Types & Instances, ER Diagrams, Enhanced Entity Relationship (EER) Model: Subclasses, Super classes, Inheritance, Specialization and Generalization, Constraints & Characteristics of Specialization and Generalization, Union/Category.

Object-Oriented & Object-Relational Databases: Object-Oriented Concepts, Object Identity Object Structure, Type Constructors, Encapsulation of operations, Methods and Persistence, Type hierarchies and Inheritance, Complex objects, Schema design for OODBMS, OQL, OODBMS architectures and Storage issues, Transaction Management & Concurrency Control.

Unit – II

Object Relational Database and Database design for an ORDBMS– Nested relations and collections; storage and access methods, Query processing and Optimization,

Advance Querying: User define data types, manipulating objects table, object views; Information Retrieval Information Retrieval & ways to retrieve information. Client/Server Architecture: Client/Server Architectures, Server Architectures

Unit – III

Parallel Databases: Architectures for Parallel Databases, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism.

Distributed Databases: ArchitecturesforDistributedDatabase,DataFragmentation,Replication, and Allocation Techniques for Distributed Database Design, Query processing in Distributed Databases; Concurrency Control and Recovery in Distributed Databases.

Unit – IV

Enhanced Data Models for Advanced Applications: Active database- syntax and semantics (DB2,Oracle), applications, design principles for active rules, Temporal database concepts, Spatial databases, Deductive databases.

Emerging Database Technologies: Mobile databases, Multimedia Databases, Geographic Information systems (GIS); XML and Internet Databases: Structured, Semi-structured and Unstructured Data, Web databases.

Suggested Readings:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education.
2. Korth, Silberchatz, Sudarshan, Database System Concepts, McGraw-Hill.
3. Raghu Rama krishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill
4. Peter Rob and Coronel, Database Systems, Design, Implementation and Management, Thomson Learning.
5. C.J. Date, Longman, Introduction to Database Systems, Pearson Education
6. Thomas Connolly, Carolyn Begg, Database Systems, Pearson Education
7. Any other book(s) covering the contents of the paper in more depth.

Note: Latest and additional good books may be suggested and added from time to time.

List of Practical / Lab Assignments
1. Write SQL commands to create tables (Students, Courses, Instructors) and insert sample data. 2. Retrieve specific data using SELECT, WHERE, ORDER BY, and GROUP BY. 3. Convert an ER diagram of a Library Management System into SQL tables. 4. Define relationships between tables (Students and Courses). 5. Write SQL queries with INNER JOIN, LEFT JOIN, and RIGHT JOIN. 6. Write SQL scripts to create tables (Employees, Employee_Log) and an AFTER INSERT trigger to log new employee entries into the log table. 7. Write a BEFORE UPDATE trigger on the Employees table to store old and new salary values in a Salary_Audit table whenever salary is updated. 8. Create a BEFORE DELETE trigger to archive student records from the Students table into a Students_Archive table before deletion. 9. Write a BEFORE INSERT trigger on the Products table to prevent insertion if the product price is less than zero. 10. Write an AFTER INSERT trigger to automatically update stock quantity in the Products table whenever a new order is added to the Orders table. ***Any other Programs/Lab Assignments given by the teachers.**

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SEC202	26BCA404SEC01	Design Thinking and Innovation	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1: Introduce students to design-based thinking approach to solve problems

CO2: Observe and assimilate unstructured information to well framed solvable problems

CO3: Introduce student to templates of ideation

CO4: Understand the importance of prototyping in the innovation journey

CO5: Implementing innovation projects

Unit – I

Basics of Design Thinking: Understand the concept of innovation and its significance in business, Understanding creative thinking process and problem solving approaches, Know Design Thinking approach and its objective, 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. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement

Unit – II

Learning to Empathize and Define the Problem: Know the importance of empathy in innovation process – how can students develop empathy using design tools, Observing and assimilating information, Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences, Identifying wicked problems around us and the potential impact of their solutions.

Unit – III

Ideate, Prototype and Implement: Know the various templates of ideation like brainstorming, systems thinking, Concept of brainstorming – how to reach consensus on wicked problems, Mapping customer

experience for ideation, Know the methods of prototyping, purpose of rapid prototyping. Implementation.
Unit – IV
Feedback, Re-Design & Re-Create: Feedback loop, focus on User Experience, address ergonomic challenges, user focused design, Final concept testing, Final Presentation – Solving Problems through innovative design concepts & creative solution.
Suggested Readings: 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 4. Design Thinking by Nigel Cross, Bloomsbury. **Note:** Latest and additional good books may be suggested and added from time to time.

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BCA
Specialization in
(AI & ML)

Semester wise Structure and Curriculum for UG Course in BCA Specialization in (AI & ML)

SEMESTER I

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)							
1	CC101	25BCA401DS01	Mathematics Foundations to Computer Science - I	3	0	0	3
2	SEC101	25BCA401SEC01	Problem Solving Techniques	3	0	4	5
3	CC102	25BCA401DS02	Computer Architecture	3	0	4	5
4	AEC101	25ENGX01AE01	General English - I	1	1	0	2
5	MDE101	25SOCX01MD01	Indian Knowledge System	2	0	0	2
6	VAC101	25CSAX01VA01	Environmental Science and sustainability	2	0	0	2
7	AEC102	25HNDX01AE01 or 25SKTX01AE01	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1- 0)) [optional course]*	1	1	0	0*
			TOTAL				**19**

Note:
L T P shown in all the tables of the scheme against the courses are w.r.t. the Workload for the semester.
^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	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC103	25BCA402DS01	Mathematics Foundations to Computer Science - II	3	0	0	3
2	CC104	25BCA402DS02	Data Structures	3	0	4	5
3	CC105	25BCA402DS03	Operating Systems	3	0	2	4
4	SEC102	25BCA402SEC01	Object Oriented Programming using Java	3	0	4	5

5	SEC103	25BCA402SEC02	Web Technologies	1	0	2	2
6	VAC102	25EVSX01AC01	Indian Constitution	2	0	0	2
7	AEC103	25HNDX03AE01 or 25SKTX03AE01	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:

5. **Skill-Based Subject**: A course designed to enhance practical and technical skills in the field of computer applications.

6. **Work-Based Vocational Course**: A vocational course offered during the summer term that emphasizes hands-on training and workplace readiness.

7. **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.

8. **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.

SEMESTER III

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC201	26BCA403DS01	Probability and Statistics	3	0	0	3
2	CC202	26BCA403DS02	Data Base Management System	3	0	4	5
3	SEC201	26BCA403SEC01	Python Programming	2	0	4	4
4	CC203	26BCA403DS03	Software Engineering	3	0	0	3
5	DSE201	26BCA403DSE21	Feature Engineering	1	0	2	3
6	VAC201	26Y0GXO4VA01/ 26SPOXO4VA02/ 26NCCXO4VA03/ 26NSSXO4VA04/ 26DMTXO4VA05	Yoga/ Sports/ NCC/ NSS/ Disaster Management	0	0	4	2
			TOTAL				**20**

SEMESTER IV

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC204	26BCA404DS01	Entrepreneurship and Startup Ecosystem	1	1	0	2
2	CC205	26BCA404DS02	Computer Networks	3	0	4	5
3	CC206	26BCA404DS03	Design and Analysis of Algorithm	3	0	0	3
4	CC207	26BCA404DS04	Artificial Intelligence	3	0	4	5
5	DSE202	26BCA404DSE21	Introduction to Machine Learning	1	0	2	3
6	SEC202	26BCA404SEC01	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:

3. **Skill-Based Subject**: A specialized course aimed at enhancing technical and practical expertise in computer applications.
4. **Work-Based Vocational Course**: A vocational course offered during the summer term, focused on building practical, industry-relevant skills.
5. **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.
6. **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.
7. **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.

Syllabus for
4-Year Bachelor Program in Computer Applications
Specialization in (AI & ML)
[Leading to BCA and BCA(Honours)/BCA(Honours) with Research Degrees]

w.e.f.
Academic Session 2025-26

SEMESTER-I

CC101	**25BCA401DS01**	**Mathematics Foundations to Computer Science - I**	**3L:0T:0P**	**3 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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 mathematical principles give a succinct abstraction of computer science problems and help them to analyze them efficiently.

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.

Suggested Readings:

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company
3. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education
4. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India
5. Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan
6. Grimaldi Ralph P. and Ramana B. V., Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education
7. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

SEC101	25BCA401SEC01	Problem Solving Techniques	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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 algorithmusing basic building blocks or structured programming constructs

CO4: Translate an algorithm into a C computer program (Create)

CO5: Testing and analysing programs using debugging tools. (Analyze)

Unit – I

Problems And Problem Instances, Generalization and Special Cases, Types of ComputationalProblems, 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

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

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 SentinelControlled Repetition using only a few Variables.

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

Unit – IV

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.

Suggested Readings:

1. Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company.
2. Gill Nasib Singh, "Handbook of Computer Fundamentals", ISBN: 978-93-82609674 Khanna Book Publishing Co.(P) Ltd, New Delhi.
3. Gill Nasib Singh, "Computing Fundamentals and Programming in C", ISBN: 978-93-81068-50-2 Pages: 832 Khanna Book Publishing Co.(P) Ltd, New Delhi.
4. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company
5. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India
6. R G Dromey, How to Solve It by Computer.
7. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson.
8. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson.

Note: Latest and additional good books may be suggested and added from time to time.

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 (>= 0) display number, square and cube of numbers from 1 to n in a tabular format?
4. Given an input positive integer number, display odd numbers from in the range [1,n]?

5. Display first mathematical tables, each table up to 10 rows? Generalise this to display first n (> 0) mathematical tables up to m (m > 0) rows?
6. Display following patterns of n rows (n > 0), For the below examples n = 5? For each pattern write a separate algorithm/program?

$ $$ $$$ $$$$ $$$$$	$ $$ $$$ $$$$ $$$$$	12345 1234 123 12 1	12345 1234 123 12 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 n1 and n2 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

16. Extract digits of an integer number (left to right and right to left)?
17. 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?
18. Check if a given positive integer number is a palindrome or not?
19. Compute character grade from the marks (0 ≤ marks ≤ 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?

20. Compute the sum of a sequence of numbers entered using sentinel controlled repetition?
21. Check if a given positive integer number is a prime number or not?
22. Compute prime factors of a positive integer number?
23. Check if two positive integer numbers are amicable numbers or not?
24. Check if a given positive integer number is a perfect number or not?
25. Check if a given positive integer number Armstrong number or not?
26. Converting a positive integer number (n > 0) from one base (inputBase) to another base (outputBase) (2 <= input Base, outputBase<= 10). Input number should be validated before converting to make sure the number uses only digits allowed in the input base?
27. 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"?
28. 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: *
29. Compute maximum, minimum, sum and average of a sequence of numbers which are read using sentinel controlled repetition using only few variables?
30. Compute body mass index, BMI = weightinKGs / (HeightinMeters *HeightinMeters), Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges:
    BMI Values
    Underweight: less than 18.5
    Normal: >=18.5 and <25
    Overweight: >=25 and < 30
    Obese: >= 30

UNIT IV

31. Design a modularized algorithm/program to check if a given positive integer number is a circular prime or not?
32. Design a modularized algorithm/program to compute a maximum of 8 numbers?
33. 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)?
34. Design a modular algorithm/program which reads an array of n integer elements and outputs median?
35. Implement your own string length and string reversal functions?
36. Design algorithm/program to perform matrix operations addition, subtraction and transpose?

37. Write a recursive program to count the number of digits of a positive integer number?
38. 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?

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CC102	25BCA401DS02	Computer Architecture	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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, Excess3 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, InputOutput 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.

Suggested Readings:

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.
3. Gill, Nasib Singh and Dixit J. B., "Digital Design and Computer Organisation", 978-81-318-0345-5 Pages: 396 University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.)
4. William Stallings- "Computer Organization and Architecture", Pearson/PHI, Sixth Edition, Andrew S. Tanenbaum- "Structured Computer Organization", PHI /Pearson 4th Edition,
5. M.V .Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.

6. Ikvinderpal Singh, Computer Organization Architecture, Khanna Book Publishing.

Note: Latest and additional good books may be suggested and added from time to time.

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

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

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AEC 101	25ENGX01AE01	General English – I	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objective:

CO1: To provide learning environment to practice listening, speaking, reading and writing skills.
CO2: To assist the students to carry on the tasks and activities through guided instructions and materials.
CO3: To effectively integrate English language learning with employability skills and training.
CO4: To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Unit – I

Vocabulary Building and Basic Writing Skills

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.

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

Unit – II

Identifying Common Errors in Writing

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

Unit – III

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 – IV

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.

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.

Suggested Readings:

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 Heasly. 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.

Note: Latest and additional good books may be suggested and added from time to time.

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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

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Indian Knowledge System

MDE 101	**25SOCX01MD01**	**Indian Knowledge System**	**2L:0T:0P**	**2 Credits**

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VAC 101	**25CSAX01VA01**	**Environmental Science and Sustainability**	**2L:0T:0P**	**2 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objectives:

CO1: This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forthcoming sustainability challenges.

CO2: This course will equip students to make decisions that consider environmental consequences.

CO3: This course will enable future business graduates to become environmentally sensitive and responsible managers.

Unit – I

Understanding Environment, Natural Resources, and Sustainability

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

Unit – II

Ecosystems, Biodiversity, and Sustainable Practices

Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The

importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation.

Unit – III

Environmental Pollution, Waste Management, and Sustainable Development

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

Unit – IV

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.

Suggested Readings:

Text Books (Latest Editions):

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

Web links:

https://www.ourplanet.com

https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

www.myfootprint.org

https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem /ecosystem.html

SEMESTER –II

CC103	25BCA402DS01	Mathematics Foundation to Computer Science - II	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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 Onlyformula 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.

Suggested Readings:

1. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education.
2. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL.
3. Taha Hamdy A., Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall.
4. S.B. Singh, Discrete Structures, Khanna Book Publishing, (AICTE Recommended Textbook)
5. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India
6. Chakravorty J. G. and Ghosh P. R., Linear Programming and Game Theory, Moulik Library.
7. Sharma J. K., Operations Research: Theory and Applications, Fourth Edition, Macmilllan Publishers.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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CC104	25BCA402DS02	Data Structures	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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 TwoDimensional 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.

Suggested Readings:

1. R.B. Patel, “Expert Data Structures with C”, Khanna Book Publishing Company (AICTE Recommended Textbook)
2. Seymour Lipschutz, “Data Structures with C”, Schaum’s Outlines, Tata McGraw-Hill.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications.
4. Reema Thareja, “Data Structures Using C", Second Edition, Oxford University Press.
5. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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.

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CC105	25BCA402DS03	Operating Systems	3L:0T:2P	4 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

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.

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.

Suggested Readings:

1. Ekta Walia, Operating Systems Concepts, Khanna Publishing House, (AICTE Recommended Textbook)
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne , Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.
3. Stallings Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.
4. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.
5. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

Note: Latest and additional good books may be suggested and added from time to time.

Operating Systems LAB

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.

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SEC102	25BCA402SEC01	Object Oriented Programming using Java	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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

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.

Unit – II

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

Operators & Expressions: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity.

Decision Making, Branching & Looping: Decision Making with Control Statements, Looping statements, Jump in loops, Labelled loops.

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.

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

Suggested Readings:

1. Balaguruswamy E. Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education
2. Schildt, H. Java: The Complete Reference. 12th edition. McGraw-Hill Education.
3. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited.
4. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited.
5. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson.
6. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press.

Web Resources

a. https://www.w3schools.com/java/.
b. http://www.java2s.com/.
c. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

Note: Latest and additional good books may be suggested and added from time to time.

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 command line arguments.
3. Write a program to send the name and surname of a student through command line arguments and print a welcome message for the student.
4. Write a java program to find the largest number out of n natural numbers.
5. Write a java program to find the Fibonacci series & Factorial of a number using recursive and non recursive functions.
6. Write a java program to multiply two given matrices.
7. Write a Java program for sorting a given list of names in ascending order.
8. Write a Java program that checks whether a given string is a palindrome or not .Ex:MADAM is a palindrome.
9. Write a java program to read n number of values in an array and display it in reverse order.
10. Write a Java program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations.
11. Create a JAVA class called Student with the following details as variables within it.

a. USN, NAME, BRANCH, PHONE, PERCENTAGE
b. Write a JAVA program to create n Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable headings.

12. Write a Java program that displays the number of characters, lines and words in a text.
13. Write a Java program to create a class called Shape with methods called getPerimeter() and getArea().

Create a subclass called Circle that overrides the getPerimeter() and getArea() methods to calculate the area and perimeter of a circle.

14. Write a Java program to create a class Employee with a method called calculateSalary(). Create two subclasses Manager and Programmer. In each subclass, override the calculateSalary() method to calculate and return the salary based on their specific roles.
15. Write a Java program using an interface called 'Bank' having function 'rate_of_interest()'. Implement this interface to create two separate bank classes 'SBI' and 'PNB' to print different rates of interest. Include additionalm ember variables, constructors also in classes 'SBI' and 'PNB'.
16. Write a Java package program for the class book and then import the data from the package and display the result.
17. Write a Java program for finding the cube of a number using a package for various data types and then import it in another class and display the results.
18. Write a Java program for demonstrating the divide by zero exception handling.
19. Write a Java program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
20. Create an exception subclass UnderAge, which prints "Under Age" along with the age value when an object of UnderAge class is printed in the catch statement. Write a class exceptionDemo in which the method test() throws UnderAge exception if the variable age passed to it as argument is less than 18. Write main() method also to show working of the program.

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SEC103	25BCA402SEC02	Web Technologies	1L:0T:2P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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 side and server side Internet Programming and basic full stack web development.

CO4:To develop modern interactive web applications.

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.

Unit – II

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 – III

Introduction to JavaScript: Functions and Events, Document Object model traversing using JavaScript. Output

System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript.Date and String handling in JavaScript.

Unit – IV

Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.

Introduction to AJAX, Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX.

Introduction to XML: uses, Key concepts, DTD 8 schemas, XSL, XSLT,and XSL Elements and transforming with XSLT. Introduction to XHTML.

JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects

Suggested Readings:

1. Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications
2. Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition
3. Silvio Moreto, Bootstrap 4 By Example, ebook.
4. 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/

Note: Latest and additional good books may be suggested and added from time to time.

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 andexternal) toformat college web page that you have created.
9. Write a HTML Program to create your college website using for mobile device.

PART – B

10. Write an HTML/JavaScript page to create login page with validations.
11. Develop a Simple calculator for addiction, subtraction, multiplication and division operation using JavaScript.
12. Use Regular Expressions for validations in Login Page using JavaScript.
13. Write a Program to retrieve date from a text file and displaying it using AJAX.
14. Create XML file to store Student Information like Register Number, Name, Mobile Number, DOB, and Email-Id.
15. Create a DTD for (0).
16. Create XML scheme for (0).
17. Create XSL file to convert XML file to XHTML file.
18. Write a JavaScript program using Switch case.
19. Write a JavaScript program using any 5 events.

20. Write a JavaScript program using built in JavaScript objects.
21. Write program for populating values from JSON text.
22. Write a program to transform JSON text to a JavaScript object.

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VAC102	25EVSX01AC01	Indian Constitution	2L:0T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objectives:

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

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

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

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

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

Unit – I

The Constitution – Introduction

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

Unit – II

Union Government

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

Unit – III

State Government

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

Unit – IV

Local Administration and Election Commission

- District Administration
- Municipal Corporation
- Zila Panchayat
- Election Commission: Role and Functioning, Chief Election Commissioner, State Election Commission

Suggested Readings:

1. Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford UniversityPress, New Delhi.

2. The Constitution of India by B.L. Fadia Sahitya Bhawan; New edition.
3. Introduction to the Constitution of India by DD Basu Lexis Nexis; Twenty-Third edition

Software/Learning Websites:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

Note: Latest and additional good books may be suggested and added from time to time.

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SEMESTER –III

CC201	26BCA403DS01	Probability and Statistics	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: To make the students trained to handle randomness scientifically using theory of probability.

CO2: 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.

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**.

Suggested Readings:

1. Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, (AICTE Recommended Textbook)
2. Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill.
3. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier.
4. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education.
5. Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI.
6. Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley.

7. Reena Garg, Engineering Mathematics, Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

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CC202	26BCA403DS02	Database Management Systems	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1:Understanding Core Concepts of DBMS

CO2:Proficiency in Database Design and SQL

CO3:Application of Advanced Database Techniques

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, ConcurrentExecution 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

Suggested Readings:

1. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill.
2. Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall
3. Brad Dayley, "NoSQL with MongoDB in 24 Hours", 1st edition, Sams Publishing.
4. Korth, Silbertz, Sudarshan," Database System Concepts", Seventh Edition, McGraw - Hill
5. R.P. Mahapatra, Govind Verma, "Database Management Systems", Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

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

1. Create the above tables
2. Add a new attribute state in supplier table
3. Remove attribute city from supplier table
4. Modify the data type of phone attribute
5. Change the name of attribute city to address
6. Change a table's name, supplier to sup
7. Use truncate to delete the contents of supplies table
8. 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 SavePoints3.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

Perform Inner, Natural, Left order and Right order join on two 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

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 a 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.

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SEC201	26BCA403SEC01	Python Programming	2L:0T:4P	4 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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.

Unit – II

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

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.

Unit – III

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

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

Unit – IV

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

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

Suggested Readings:

1. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House.
2. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House.
3. Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson.
4. Think Python, by Allen Downey, 2nd edition,O’Reilly. https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view
5. An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.

6. Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition, 2016, PHI India.

Note: Latest and additional good books may be suggested and added from time to time.

List of Practicals

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) witht1.
    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.

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CC203	26BCA403DS03	Software Engineering	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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.

Suggested Readings:

1. Nasib Singh Gill, Software Engineering, Khanna Publishing House,(AICTE Recommended Textbook)
2. Ian Somerville, Software Engineering, 9th edition, Pearson education.
3. Roger S Pressman, Bruce R. Maxim., Software Engineering A practitioner's Approach, 8th edition, McGraw Hill Education.
4. Stephen Schach, Software Engineering 7th ed, McGraw-Hill.
5. Hans van Vliet ,Software Engineering: Principles and Practice

Note: Latest and additional good books may be suggested and added from time to time.

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DSE201	26BCA403DSE21	Feature Engineering	1L:0T:4P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Outcomes

CO1: Understand the importance of features in machine learning and differentiate between various types of data and features (structured vs. unstructured, categorical, numerical, text, and date-time).

CO2: Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization.

CO3: Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation.

CO4: Utilize categorical data techniques, such as one-hot encoding and label encoding, and understand feature selection methods, including filter and wrapper methods.

CO5: Perform feature transformation using techniques like Principal Component Analysis (PCA) and understand its application in machine learning

Unit – I

Introduction to Feature Engineering: Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio.

Unit – II

Basic Feature Engineering: Basic Feature Preprocessing: Handling Missing Data, Data Cleaning, Feature Scaling, Normalization, and Transformation.

Unit – III

Feature Engineering Techniques-I

Techniques for Numerical Data: Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques: One Hot Encoding, Label Encoding.

Unit – IV

Feature Engineering Techniques-II

Feature extraction vs. feature selection, Steps in feature selection. Feature Selection Methods: Filter, Wrapper, and Hybrid. Feature Reduction: Introduction and application of Principal Components Analysis.

Suggested Readings:

1. M.C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024.
2. Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning: Principles and techniques for data scientists. O'Reilly Media, Inc.
3. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN-13: 9780323917780.
4. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
5. N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024.
6. M.C. Trivedi, Deep Learning and Neural Network_MC Trivedi, Khanna Publishing House, 2024.
7. Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500.
8. Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791.
9. Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). Introduction to data

mining (2nd ed.). Pearson. ISBN 978-9354491047.
10. Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, Inc.
11. Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating, engineering, and transforming features to build machine learning models. Packt Publishing, Limited.
12. Nielsen, Aileen. (2019). Practical time series analysis: Prediction with statistics and machine learning. O'Reilly Media.

Note: Latest and additional good books may be suggested and added from time to time.

Feature Engineering Laboratory

LAB Experiments

The lab experiments can be implemented in Python using relevant libraries such as numpy, pandas, sklearn, nltk, matplotlib, and seaborn. Kaggle datasets, public repositories (e.g., UCI, Machine Learning etc.), or generated datasets can be used for conducting the experiments. Experiments may be conducted on numerical, image, or time-series datasets.

1. Handle missing values in column(s) of a dataset. For example, fill missing values with the mean/median/mode of the columns such as ‘Age’, ‘Height’, ‘Weight’, ‘Grade’ for a dataset.
2. Clean a dataset by identifying and removing invalid data entries. For example, a dataset having columns 'Name', ‘Gender’ and 'Age' where 'Name' contains 'invalid data'.
3. Scale numerical features using Min-Max normalization for a dataset with columns like ‘Height', ‘Weight’.
4. Perform exploratory data analysis and visualize data distributions using histograms and boxplots.
5. Compute and visualize the correlation matrix of a dataset with 2 or more columns.
6. Bin numerical data into discrete intervals for a dataset with a column containing numerical values.
7. Create polynomial and interaction features from numerical data in a dataset with two columns.
8. Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'.
9. Perform one-hot encoding on categorical features in a dataset with column 'Category' containing categorical values. The distinct values in the Category feature are [Good, Better, Best] and Gender [Male, Female].
10. Preprocess text data (tokenization) for a dataset with a column 'Text'.
11. Preprocess text data (stemming) for a dataset with a column 'Text'.
12. Preprocess text data (lemmatization) for a dataset with a column 'Text'.
13. Convert text data into a Bag-of-Words representation for a dataset with a column 'Text'.
14. Apply TF-IDF transformation to text data for a column 'Text'.
15. Perform image augmentation (resizing, normalization, rotation, translation) for a set of images.
16. Perform image augmentation resizing for a set of images.
17. Perform image augmentation normalization for a set of images.
18. Perform image augmentation rotation for a set of images.
19. Perform image augmentation translation for a set of images.
20. Decompose a time series into trend, seasonal, and residual components for a dataset with a column 'TimeSeries'.
21. Perform Principal Component Analysis (PCA) on a dataset and visualize the first two principal components.

***Any other programs assigned by the teachers.**

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VAC201	26YOGX04VA01	Yoga and Physical fitness	0L:0T:4P	2 Credits

Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

Course Objective(s):

CO1: Understand yoga's significance and its practical applications for holistic well-being.
CO2: Explore subtle energy systems and their role in enhancing health through yogic practices.
CO3: Examine various paths of yoga to foster self-realization and spiritual growth.
CO4: Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.
CO5: Apply yogic principles to manage psycho-somatic ailments and promote resilience.

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 yaga, 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, dhyan, 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

Suggested Readings:

- 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.

VAC201	26SPOX04VA02	Sports Management	0L:0T:4P	2 Credits

Sports Management

Course Objective(s):

CO1: Understand the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations.

CO2:Analyse the role of marketing and sponsorship in the sports industry, with a focus on branding, target audience segmentation, and event management.

CO3: Develop proficiency in financial management techniques specific to the sports industry, including revenue generation, cost management, and investment strategies.

CO4: Explore the application of analytics and technology in sports, including performance evaluation, strategic decision-making, and fan engagement.

CO5: Apply theoretical knowledge to practical scenarios through case studies and projects, fostering critical thinking and problem-solving skills in sports management contexts.

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 modelling, Key performance indicators (KPIs) in sports, Applications of analytics: talent scouting, injury prevention, performance optimization.

Suggested Readings :

1. Pedersen, P. M., Thibault, L., & Pedersen, P. M. Contemporary Sport Management. Human Kinetics.
2. Hoye, R., Smith, A. C. T., Nicholson, M., et al., Sports Management: Principles and Applications. Routledge.
3. Chelladurai, P., & Kerwin, S. Introduction to Sport Management: Theory and Practice. Human Kinetics.
4. Hoye, R., Cuskelly, G., & Nicholson, M. Sports Governance: A Guide for Sport Organizations. Routledge.
5. Conrad, M. The Business of Sports: A Primer for Journalists. Routledge.
6. Shank, M. D. Sports Marketing: A Strategic Perspective. Pearson.
7. Collett, P., & Fenton, W. The Sponsorship Handbook: Essential Tools, Tips and Techniques for Sponsors and Sponsorship Seekers. Kogan Page.

8. Fullerton, S. Jr., & Funk, D. C. Sports Marketing: A Practical Approach. Routledge.
9. Conrad, M. Winning in Sports Business: Essential Marketing, Finance, and Management Strategies. Routledge.
10. McCarty, L. A., & McPherson, G. Sports Event Management: The Caribbean Experience. Routledge.
11. Brown, M. T., Rascher, D., & Leeds, M. A. Financial Management in the Sport Industry. Routledge.

VAC201	26NCCX04VA03	NCC	0L:0T:4P	2 Credits

NATIONAL CADET CORPS (NCC)

Course Objective(s):

CO1: Understand the foundational role of drill in fostering discipline and leadership within a group, enabling effective command towards achieving common goals.

CO2: Appreciate the importance of grace and dignity in executing foot drill movements, recognizing their significance in enhancing performance and teamwork.

CO3: Comprehend the criticality of weapon handling and detailed safety measures, emphasizing the importance of accident prevention through strict adherence to safety protocols.

CO4: 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.

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

Suggested Readings:

1. DGNCC Cadet's Hand Book - Common Subjects -All Wings
2. Tiwari, R. NCC: Grooming Feeling of National Integration, Leadership and Discipline among Youth. Edwin Incorporation.
3. Chhetri, R.S. Grooming Tomorrows Leaders, The National Cadet Corps.
4. Directorate General National Cadet Corps. National Cadet Corps, Youth in Action.
5. Vanshpal, Ravi. The NCC Days, Notion Press.

VAC201 26NSSX04VA04 NATIONAL SERVICE SCHEME (NSS) 0L:0T:4P 02 Credits

NATIONAL SERVICE SCHEME (NSS)

Course Objectives:

CO1: To provide students with an understanding of the history, philosophy, and basic concepts of the National Service Scheme (NSS).

CO2: To familiarize students with the aims, objectives, and organizational structure of NSS.

CO3: To equip students with knowledge about NSS programmes, activities, and their relevance.

CO4: To develop an understanding of community mobilization techniques and their importance in NSS activities.

CO5: To cultivate an appreciation for volunteerism, shramdan (voluntary labor), and their role in community development initiatives.

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 Swatch Bharat Abhiyan and Digital India

Suggested Readings:

1. Ministry of Youth Affairs and Sports, Government of India. National Service Scheme (NSS) Manual.
2. Agarwalla, S. NSS and Youth Development. Mahaveer Publications
3. Bhattacharya, P. Stories Of NSS (English Version). Sahityasree.
4. Borah, R. and Borkakoty, B. NSS in Socioeconomic Development. Unika Prakashan.
5. Wondimu, H., & Admas, G. 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.. Extension Education–The Third Dimension Needs and Aspirations of Indian Youth. *Journal of Social Sciences*, *6*(3), 209-214.
7. Mills, S. "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. Mukherji, B. Community Development in India. Orient Longmans.

VAC201 26NSSX04VA05 DISASTER MANAGEMENT 0L:0T:4P 02 Credits

DISASTER MANAGEMENT

Course Objectives:

CO1: to provide understanding of the concepts related to disaster

CO2: to highlight the importance and role of disaster management

CO3: to enhance awareness of institutional processes and management strategies to mitigate the impacts of disasters

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.**

Suggested Readings

1. Sharma, S.C. Disaster Management, Khanna Book Publishing.
2. Clements, B. W., Disasters and Public Health: Planning and Response, Elsevier Inc.
3. Dunkan, K., and Brebbia, C. A., (Eds.) Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK.
4. Singh, R. B. (ed.),Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.
5. Ramkumar, Mu, Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Modh, S., Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.
7. Carter, N., 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., Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.

SEMESTER –IV

CC204	26BCA404DS01	Entrepreneurship and Startup Ecosystem	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: To understand Entrepreneurship and its types

CO2: To understand that not all ideas can be turned into viable business models and estimate business potential of an idea

CO3: To understand different type of finances available and financing methods

CO4: To be able to draft business plans on an identified idea

CO5: To understand the nuances of operating a startup – low budget marketing, stabilizing operations, build a team from scratch and scaling the business

CO6: To know what is a Family Business and how is it different from Entrepreneurship

Unit – I

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 – II

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 – III

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 – IV

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.

Suggested Readings:

1. Startup India Leaning Programby Start Up India available at www.startupindia.gov.in
2. Entrepreneurship, Rajeev Roy, Oxford University Press
3. Entrepreneurship: Successfully Launching New Venturesby R. Duane Ireland Bruce R. Barringer, Pearson Publishing
4. Family Business Management by Rajiv Agarwal, Sage Publishing
5. Mapping the Startup Ecosystem in India, Anish Tiwari ,*Economic& Political Weekly*
6. Indian Family Businesses: Their survival beyond three generations, Ramachandran, K, ISB Working Paper Series

Note: Latest and additional good books may be suggested and added from time to time.

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CC205	26BCA404DS02	Computer Networks	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

Unit – I

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 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: 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 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.

Suggested Readings:

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson.
3. Gill, Nasib Singh, “Essentials of Computer and Network Technology”, ISBN: 81-87522-71-2 Pages:

340 Khanna Book Publishing Co. (P) Ltd, New Delhi.
4. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education.
5. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann.
6. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House.
Mastering PC Hardware & Networking, Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

Lab Programs

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

***Any other Programs/Lab Assignments given by the teachers.**

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CC206	26BCA404DS03	Design and Analysis of Algorithms	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1:To impart to students the understanding of basic algorithm designing paradigms.
CO2:To introduce the basic knowledge on how to analyse an algorithm.
CO3:To enable a student to synthesize efficient algorithms in common design situations and real-life problems.

Unit – I

Introduction: 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.
Suggested Readings: 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. 3. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd. 4. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson. 5. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston. 6. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education. **Note:** Latest and additional good books may be suggested and added from time to time.

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CC207	**26BCA404DS04**	**Artificial Intelligence**	**3L:0T:4P**	**5 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

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

Unit – I

Introduction to Al: Introduction, 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.

Suggested Readings:

1. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, (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 .
4. Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company.
5. Russell, S. and Norvig, P., “Artificial Intelligence - A Modern Approach”, 3rd edition, Prentice
6. Van Hirtum, A. & Kolski, C. Constraint Satisfaction Problems: Algorithms and Applications. Springer

Note: Latest and additional good books may be suggested and added from time to time.

Lab Assignments

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.

***Any other Programs/Lab Assignments given by the teachers.**

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DSE202	26BCA404DSE21	Introduction to Machine Learning	1L:0T:4P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1: Define and explain machine learning concepts, types, and basic metrics.

CO2: Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, Logistic Regression).

CO3: Apply unsupervised learning methods (e.g., K-Means, Hierarchical Clustering, Association Rules).

CO4: Develop and evaluate simple machine learning models (e.g., Perceptron, single-layer neural networks).

CO5: Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.

Unit – I

Introduction to Machine Learning: Definition, History and Application of Machine Learning, Types of

Machine Learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. Supervised Learning Tasks: Regression vs. Classification

Unit – II

Learning Framework and Evaluation Parameters: Learning Framework: Training, Validation and Testing of ML models. Performance Evaluation Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.

Unit – III

Supervised Learning and Unsupervised Learning I

Regression: Linear and non-linear Regression, Logistic Regression. Classification: Naïve Bayes, K-Nearest Neighbors, Decision Trees. Linear model: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron

Unit – IV

Supervised Learning and Unsupervised Learning II

Introduction to Support Vector Machine for linearly separable data. Clustering: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. ML Applications: Ethical Considerations in Machine Learning, Case study and Real-world Applications.

Suggested Readings:

1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.
3. Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.
4. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780
5. Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012.
6. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
7. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.
8. Chollet, F. (2018). Deep Learning with Python. Manning Publications.
9. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
10. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
11. Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media.

Note: Latest and additional good books may be suggested and added from time to time.

List of Practical / Lab Assignments

Prerequisites: Understanding of machine learning algorithms and concepts (e.g., classification, clustering, regression). Proficiency in Python programming, with experience using libraries such as NumPy, pandas, Scikit-Learn, NLTK, Matplotlib, and Seaborn.

LAB Experiments

The lab experiments may be implemented in Python using relevant ML libraries, and datasets from Kaggle, public repositories, or generated datasets.

Suggested list of Experiments (not limited to):

1. Implement linear regression on a dataset and visualize the regression line.
2. Implement logistic regression on a binary classification dataset and plot the decision boundary.
3. Implement and evaluate the performance of Decision tree ID3/Cart classifier for any given dataset.

4. Implement and evaluate the performance of the Naive Bayes Classifier on a given dataset.
5. Build and evaluate a random forest classifier using a numerical dataset.
6. Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary.
7. Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.
8. Implement hierarchical clustering on a dataset and plot the dendrogram.
9. Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.
10. Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.
11. Build a single layer perceptron model to classify AND, OR, and XOR problems (may use TensorFlow/Keras) and visualize their decision boundaries. Also evaluate its performance.
12. Demonstrate the concept of boosting using the AdaBoost algorithm.

***Any other Programs/Lab Assignments given by the teachers.**

SEC 202	26BCA404SEC01	Design Thinking and Innovation	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1: Introduce students to design-based thinking approach to solve problems
CO2: Observe and assimilate unstructured information to well framed solvable problems
CO3: Introduce student to templates of ideation
CO4: Understand the importance of prototyping in the innovation journey
CO5: Implementing innovation projects

Unit – I

Basics of Design Thinking: Understand the concept of innovation and its significance in business, Understanding creative thinking process and problem solving approaches, Know Design Thinking approach and its objective, 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. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement

Unit – II

Learning to Empathize and Define the Problem: Know the importance of empathy in innovation process – how can students develop empathy using design tools, Observing and assimilating information, Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences, Identifying wicked problems around us and the potential impact of their solutions.

Unit – III

Ideate, Prototype and Implement: Know the various templates of ideation like brainstorming, systems thinking, Concept of brainstorming – how to reach consensus on wicked problems, Mapping customer experience for ideation, Know the methods of prototyping, purpose of rapid prototyping. Implementation.

Unit – IV

Feedback, Re-Design & Re-Create: Feedback loop, focus on User Experience, address ergonomic challenges, user focused design, Final concept testing, Final Presentation – Solving Problems through innovative design concepts & creative solution.

Suggested Readings:

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
4. Design Thinking by Nigel Cross, Bloomsbury.

Note: Latest and additional good books may be suggested and added from time to time.

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BCA
Specialization in
(Data Science)

Semester wise Structure and Curriculum for UG Course in BCA Specialization in Data Science

SEMESTER I

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)							
1	CC101	25BCA401DS01	Mathematics Foundations to Computer Science - I	3	0	0	3
2	SEC101	25BCA401SEC01	Problem Solving Techniques	3	0	4	5
3	CC102	25BCA401DS02	Computer Architecture	3	0	4	5
4	AEC101	25ENGX01AE01	General English - I	1	1	0	2
5	MDE101	25SOCX01MD01	Indian Knowledge System	2	0	0	2
6	VAC101	25CSAX01VA01	Environmental Science and sustainability	2	0	0	2
7	AEC102	25HNDX01AE01 or 25SKTX01AE01	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1- 0)) [optional course]*	1	1	0	0*
			TOTAL				**19**

Note:
L T P shown in all the tables of the scheme against the courses are w.r.t. the Workload for the semester.
^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	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC103	25BCA402DS01	Mathematics Foundations to Computer Science - II	3	0	0	3
2	CC104	25BCA402DS02	Data Structures	3	0	4	5
3	CC105	25BCA402DS03	Operating Systems	3	0	2	4

4	SEC102	25BCA402SEC01	Object Oriented Programming using Java	3	0	4	5
5	SEC103	25BCA402SEC02	Web Technologies	1	0	2	2
6	VAC102	25EVSX01AC01	Indian Constitution	2	0	0	2
7	AEC103	25HNDX03AE01 or 25SKTX03AE01	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.

SEMESTER III

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC201	26BCA403DS01	Probability and Statistics	3	0	0	3
2	CC202	26BCA403DS02	Data Base Management System	3	0	4	5
3	SEC201	26BCA403SEC01	Python Programming	2	0	4	4
4	CC203	26BCA403DS03	Software Engineering	3	0	0	3
5	DSE201	26BCA403DSE11	Basics of Data Analytics using Spreadsheet				3
6	VAC201	26Y0GXO4VA01/ 26SPOXO4VA02/ 26NCCXO4VA03/ 26NSSXO4VA04/ 26DMTXO4VA05	Yoga/ Sports/ NCC/ NSS/ Disaster Management	0	0	4	2
			TOTAL				**20**

SEMESTER IV

S. No.	Course Code	University Nomenclature Course Code	Course Title	L	T	P	Credit
1	CC204	26BCA404DS01	Entrepreneurship and Startup Ecosystem	1	1	0	2
2	CC205	26BCA404DS02	Computer Networks	3	0	4	5
3	CC206	26BCA404DS03	Design and Analysis of Algorithm	3	0	0	3
4	CC207	26BCA404DS04	Artificial Intelligence	3	0	4	5
5	DSE202	26BCA404DSE11	Data Visualization	1	0	4	3
6	SEC202	26BCA404SEC01	Design Thinking and Innovation	1	1	0	2
			TOTAL				**20**

Note:

3. 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.
4. 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.

Syllabus for
4-Year Bachelor Program in Computer Applications
Specialization in Data Science
[Leading to BCA and BCA(Honours)/BCA(Honours) with Research Degrees]

w.e.f.
Academic Session 2025-26

SEMESTER-I

CC101	**25BCA401DS01**	**Mathematics Foundations to Computer Science - I**	**3L:0T:0P**	**3 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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 mathematical principles give a succinct abstraction of computer science problems and help them to analyze them efficiently.

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.

Suggested Readings:

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company
3. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education
4. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India
5. Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan
6. Grimaldi Ralph P. and Ramana B. V., Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education
7. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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SEC101	25BCA401SEC01	Problem Solving Techniques	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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

CO4: Translate an algorithm into a C computer program (Create)

CO5: Testing and analysing programs using debugging tools. (Analyze)

Unit – I
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
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
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 SentinelControlled Repetition using only a few Variables. C Language: else-if Ladder, switch Case, Increment/Decrement Operators, break and continue Statements.
Unit – IV
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.
Suggested Readings: 1. Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company. 2. Gill Nasib Singh, "Handbook of Computer Fundamentals", ISBN: 978-93-82609674 Khanna Book Publishing Co.(P) Ltd, New Delhi. 3. Gill Nasib Singh, "Computing Fundamentals and Programming in C", ISBN: 978-93-81068-50-2 Pages: 832 Khanna Book Publishing Co.(P) Ltd, New Delhi.

4. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company
5. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India
6. R G Dromey, How to Solve It by Computer.
7. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson.
8. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson.

Note: Latest and additional good books may be suggested and added from time to time.

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 (>= 0) display number, square and cube of numbers from 1 to n in a tabular format?
4. Given an input positive integer number, display odd numbers from in the range [1,n]?
5. Display first mathematical tables, each table up to 10 rows? Generalise this to display first n (> 0) mathematical tables up to m (m > 0) rows?
6. Display following patterns of n rows (n > 0), For the below examples n = 5? For each pattern write a separate algorithm/program?

$ $$ $$$ $$$$ $$$$$	$ $$ $$$ $$$$ $$$$$	12345 1234 123 12 1	12345 1234 123 12 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 n1 and n2 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 ≤ marks ≤ 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 <= input Base, outputBase<= 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, BMI = weightinKGs / (HeightinMeters *HeightinMeters), Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges:
    BMI Values
    Underweight: less than 18.5
    Normal: >=18.5 and <25
    Overweight: >=25 and < 30
    Obese: >= 30

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?

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CC102	25BCA401DS02	Computer Architecture	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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, Excess3 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.

Suggested Readings:

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.
3. Gill, Nasib Singh and Dixit J. B., "Digital Design and Computer Organisation", 978-81-318-0345-5 Pages: 396 University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.)
4. William Stallings- "Computer Organization and Architecture", Pearson/PHI, Sixth Edition,
5. Andrew S. Tanenbaum- "Structured Computer Organization", PHI /Pearson 4th Edition,
6. M.V .Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.
7 Ikvinderpal Singh, Computer Organization Architecture, Khanna Book Publishing.

Note: Latest and additional good books may be suggested and added from time to time.

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.

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AEC 101	**25ENGX01AE01**	**General English – I**	**1L:1T:0P**	**2 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objective:

CO1: To provide learning environment to practice listening, speaking, reading and writing skills.
CO2: To assist the students to carry on the tasks and activities through guided instructions and materials.
CO3: To effectively integrate English language learning with employability skills and training.
CO4: To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Unit – I

Vocabulary Building and Basic Writing Skills 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. Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely
Unit – II
Identifying Common Errors in Writing Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundant
Unit – III
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 – IV
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. Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.
Suggested Readings: 1. AICTE's Prescribed Textbook: Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book Publishing Co., 2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing. 3. Practical English Usage. Michael Swan. OUP. 4. Remedial English Grammar. F.T. Wood. Macmillan. 5. On Writing Well. William Zinsser. Harper Resource Book. 6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press. **Note:** Latest and additional good books may be suggested and added from time to time.

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

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Indian Knowledge System

MDE 101	**25SOCX01MD01**	**Indian Knowledge System**	**2L:0T:0P**	**2 Credits**

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VAC 101	**25CSAX01VA01**	**Environmental Science and Sustainability**	**2L:0T:0P**	**2 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objectives:

CO1: This course aims to familiarize students with basic environmental concepts, their relevance to business operations, and forthcoming sustainability challenges.

CO2: This course will equip students to make decisions that consider environmental consequences.

CO3: This course will enable future business graduates to become environmentally sensitive and responsible managers.

Unit – I

Understanding Environment, Natural Resources, and Sustainability

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

Unit – II

Ecosystems, Biodiversity, and Sustainable Practices

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

Unit – III
Environmental Pollution, Waste Management, and Sustainable Development Various types of environmental pollution, including air, water, noise, soil, and marine pollution, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts.
Unit – IV
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.
Suggested Readings: 1. Poonia, M.P. *Environmental Studies* (3rd ed.), Khanna Book Publishing Co. 2. Bharucha, E. *Textbook of Environmental Studies* (3rd ed.) Orient Blackswan Private Ltd. 3. Dave, D., &Katewa, S. S. *Text Book of Environmental Studies.* Cengage Learning India Pvt Ltd. 4. Rajagopalan, R. *Environmental studies: from crisis to cure* (4th ed.). Oxford University Press. 5. Miller, G.T. &Spoolman S. *Living in the Environment*. (20th ed.). Cengage. 6. Basu, M., & Xavier Savarimuthu, S. J. *Fundamentals of environmental studies*. Cambridge University Press. 7. Roy, M. G. *Sustainable Development: Environment, Energy and Water Resources*. Ane Books. 8. Pritwani, K. *Sustainability of business in the context of environmental management.* CRC Press. 9. Wright, R.T. & Boorse, D.F. *Environmental Science: Toward A Sustainable Future* (13th ed,). Pearson. **Web links:** https://www.ourplanet.com https://www.undp.org/content/undp/en/home/sustainable-development-goals.html www.myfootprint.org https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem /ecosystem.html

SEMESTER –II

CC103	25BCA402DS01	Mathematics Foundation to Computer Science - II	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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 Onlyformula 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.

Suggested Readings:

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

3. Taha Hamdy A., Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall.
4. S.B. Singh, Discrete Structures, Khanna Book Publishing, (AICTE Recommended Textbook)
5. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India
6. Chakravorty J. G. and Ghosh P. R., Linear Programming and Game Theory, Moulik Library.
7. Sharma J. K., Operations Research: Theory and Applications, Fourth Edition, Macmilllan Publishers.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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CC104	25BCA402DS02	Data Structures	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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.

Suggested Readings:

1. R.B. Patel, "Expert Data Structures with C", Khanna Book Publishing Company (AICTE Recommended Textbook)
2. Seymour Lipschutz, "Data Structures with C", Schaum's Outlines, Tata McGraw-Hill.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications.
4. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press.
5. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press.

Web Resources

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

Note: Latest and additional good books may be suggested and added from time to time.

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.

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CC105	25BCA402DS03	Operating Systems	3L:0T:2P	4 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

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.

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.

Suggested Readings:

1. Ekta Walia, Operating Systems Concepts, Khanna Publishing House, (AICTE Recommended Textbook)
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne , Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.
3. Stallings Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.
4. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.
5. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

Note: Latest and additional good books may be suggested and added from time to time.

Operating Systems LAB

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.

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SEC102	25BCA402SEC01	Object Oriented Programming using Java	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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

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.

Unit – II

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

Operators & Expressions: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity.

Decision Making, Branching & Looping: Decision Making with Control Statements, Looping statements, Jump in loops, Labelled loops.

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.

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

Suggested Readings:

1. Balaguruswamy E. Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education
2. Schildt, H. Java: The Complete Reference. 12th edition. McGraw-Hill Education.
3. Arunesh Goyal, The Essentials of JAVA, Khanna Book Publishing Company Private Limited.
4. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited.

5. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson.
6. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press.

Web Resources

a. https://www.w3schools.com/java/.
b. http://www.java2s.com/.
c. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

Note: Latest and additional good books may be suggested and added from time to time.

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

numbers are duplicates.

20. Create an exception subclass UnderAge, which prints "Under Age" along with the age value when an object of UnderAge class is printed in the catch statement. Write a class exceptionDemo in which the method test() throws UnderAge exception if the variable age passed to it as argument is less than 18. Write main() method also to show working of the program.

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SEC103	25BCA402SEC02	Web Technologies	1L:0T:2P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

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 side and server side Internet Programming and basic full stack web development.

CO4:To develop modern interactive web applications

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.

Unit – II

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 – III

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

Unit – IV

Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.

Introduction to AJAX, Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX.

Introduction to XML: uses, Key concepts, DTD 8 schemas, XSL, XSLT,and XSL Elements and transforming with XSLT. Introduction to XHTML.
JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects

Suggested Readings:

1. Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications
2. Thomas A. Powell,The Complete Reference HTML & CSS, Fifth Edition
3. Silvio Moreto, Bootstrap 4 By Example, ebook.
4. Tanweer Alam, Web Technologies, Khanna Book Publishing, 2011.

Web Resources

a) www.javatpoint.com
b) www.w3schools.com
c) https://www.geeksforgeeks.org/web-technology/

Note: Latest and additional good books may be suggested and added from time to time.

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 andexternal) toformat college web page that you have created.
9. Write a HTML Program to create your college website using for mobile device.

PART – B

10. Write an HTML/JavaScript page to create login page with validations.
11. Develop a Simple calculator for addiction, subtraction, multiplication and division operation using JavaScript.
12. Use Regular Expressions for validations in Login Page using JavaScript.
13. Write a Program to retrieve date from a text file and displaying it using AJAX.
14. Create XML file to store Student Information like Register Number, Name, Mobile Number, DOB, and Email-Id.
15. Create a DTD for (0).
16. Create XML scheme for (0).
17. Create XSL file to convert XML file to XHTML file.
18. Write a JavaScript program using Switch case.
19. Write a JavaScript program using any 5 events.
20 Write a JavaScript program using built in JavaScript objects.
21Write program for populating values from JSON text.
22 Write a program to transform JSON text to a JavaScript object.

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VAC102	25EVSX01AC01	Indian Constitution	2L:0T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer type questions covering the entire syllabus. Student will be required to attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory.

Course Objectives:

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

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

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

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

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

Unit – I

The Constitution – Introduction

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

Unit – II

Union Government

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

Unit – III

State Government

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

Unit – IV

Local Administration and Election Commission

- District Administration
- Municipal Corporation
- Zila Panchayat
- Election Commission: Role and Functioning, Chief Election Commissioner, State Election Commission

Suggested Readings:

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

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/

Note: Latest and additional good books may be suggested and added from time to time.

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SEMESTER –III

CC201	26BCA403DS01	Probability and Statistics	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: To make the students trained to handle randomness scientifically using theory of probability.

CO2: 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.

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**.

Suggested Readings:

1. Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, (AICTE Recommended Textbook)
2. Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill.
3. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th

Edition, Elsevier.
4. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education.
5. Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI.
6. Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley.
7. Reena Garg, Engineering Mathematics, Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

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CC202	26BCA403DS02	Database Management Systems	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1:Understanding Core Concepts of DBMS

CO2:Proficiency in Database Design and SQL

CO3:Application of Advanced Database Techniques

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

Suggested Readings:

1. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill.
2. Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall
3. Brad Dayley, "NoSQL with MongoDB in 24 Hours", 1st edition, Sams Publishing.
4. Korth, Silbertz, Sudarshan," Database System Concepts", Seventh Edition, McGraw - Hill
5 R.P. Mahapatra, Govind Verma, "Database Management Systems", Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

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

1. Create the above tables
2. Add a new attribute state in supplier table
3. Remove attribute city from supplier table
4. Modify the data type of phone attribute
5. Change the name of attribute city to address
6. Change a table's name, supplier to sup
7. Use truncate to delete the contents of supplies table
8. 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 SavePoints3.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

Perform Inner, Natural, Left order and Right order join on two tables

Set Theory Operators

1. Show the use of UNION operator with union compatibility
2. 2.Show the use of intersect operator with union compatibility
3. Show the use of minus operator with union compatibility

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 a 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.

***Any other programs assigned by the teachers.**

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SEC201	26BCA403SEC01	Python Programming	2L:0T:4P	4 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

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.

Unit – II

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

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.

Unit – III
Mutable and Immutable objects: Lists, Tuples and Dictionaries; Commonly usedFunctions on Lists, Tuples and Dictionaries. Passing Lists and Dictionaries as arguments to Functions using Math and Numpy module for list of integers and arrays. **Files:** Types of Files. Creating, Reading and Writing on Text and Binary Files. The Pickle Module. Reading and Writing CSV and JSON Files.
Unit – IV
Exception Handling: Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions. Data visualization: Plotting various 2D and 3D graphics; Histogram; Pi charts; Sine and cosine curves.

Suggested Readings:

1. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House.
2. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House.
3. Sheetal Taneja &Naveenkumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson.
4. Think Python, by Allen Downey, 2nd edition,O'Reilly. https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view
5. An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.
6. Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition, PHI India.

Note: Latest and additional good books may be suggested and added from time to time.

List of Practicals

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.
   - i Find the frequency of a character in a string.
   - ii Replace a character by another character in a string.
   - iii Remove the first occurrence of a character from a string.
   - iv 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) witht1.
    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.

***Any other programs assigned by the teachers.**

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CC203	26BCA403DS03	Software Engineering	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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 decisionmaking for successful software project execution.

CO3:To Master the art of software design, development, and testing to produce robust and efficient software solutions.

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.

Suggested Readings:

1. Nasib Singh Gill, Software Engineering, Khanna Publishing House,(AICTE Recommended Textbook)
2. Ian Somerville, Software Engineering, 9th edition, Pearson education.
3. Roger S Pressman, Bruce R. Maxim. Software Engineering A practitioner's Approach, 8th edition, McGraw Hill Education.
4. Stephen Schach, Software Engineering 7th ed, McGraw-Hill.
5. Hans van Vliet , Software Engineering: Principles and Practice

Note: Latest and additional good books may be suggested and added from time to time.

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DSE201	26BCA403DSE11	Basics of Data Analytics using Spreadsheet	1L:0T:4P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: Understand the basics of data analytics and its applications.
CO2: Develop proficiency in using spreadsheet software for data manipulation and analysis.
CO3: Build and use spreadsheet models for decision making effectively.
CO4: Create formulae and functions to enhance output.
CO5: Better understanding and usage of Visualization tools for presenting results effectively.

Unit – I

Introduction to Data Analytics

Fundamentals of Data Analysis, Statistical Foundation for Data Analysis, Types of Data: Structured, Unstructured, Semi-structured. Descriptive Statistics, Correlation and Covariance. Linear Regression.

Unit – II

Data Handling

Spreadsheet Concepts, Managing Worksheets, Formatting Cells, Entering data. Handling Operators in Formula. Sorting, Multilayer Sorting. Data Validation, Filter, Pivot tables, Formulae and Functions.

Unit – III

Data Analysis

Explore a Data Model: Contents and its Structure (Power Point add-in). DAX Formula Language. Creation of Calculated fields and Measures for each cell.

Unit – IV

DataVisualization

Different types of Charts: Pivot Charts, Column, Line, Pie, Bar, Scatter charts. Fine Tuning of Charts: Chart elements, styles, filters and Box Plot.

Suggested Readings:

1. Elementary Statistical Methods, Gupta, S. P., Sultan Chand and Sons, New Delhi.
2. Advanced Excel Essentials, Goldmeier, J., Apress.
3. Beginner's Guide for Data Analysis, Jeeva Jose, Khanna Publishing House.
4. Data Analytics, V.K. Jain, Khanna Book Publishing Company.
5. Excel Data Analysis For Dummies, Stephen L. Nelson and E. C. Nelson, John Wiley & Sons; 3rd edition.
6. Data Analysis Using Microsoft Excel, Michael R. Middleton, Thomson, Brooks/Cole, 3rd edition.

Note: Latest and additional good books may be suggested and added from time to time.

Basics of Data Analytics using Spreadsheet: Lab Program List

PART – A: Understanding and Describing the Data

Introduction to Excel and Basic Functions

1. Getting started with Excel: Workbook, Worksheet, Cells, and Ranges
2. Data entry and basic formatting techniques
3. Using basic arithmetic functions: SUM, AVERAGE, MIN, MAX, ROUND
4. Introduction to cell referencing: relative, absolute, and mixed

Data Importing and Pre-processing

1. Importing data from various sources (CSV, text files, web data)
2. Data cleaning: removing duplicates, handling missing data, and standardizing formats
3. Data transformation: text-to-columns, data validation techniques
4. Using the "Find & Replace" and "Text Functions" (LEFT, RIGHT, MID, CONCATENATE)

Descriptive Statistics Using Excel

1. Calculating measures of central tendency: mean, median, mode
2. Computing measures of dispersion: range, variance, standard deviation
3. Creating and interpreting frequency distributions and histograms
4. Using Excel's "Data Analysis Toolpack" for basic statistical analysis

PART- B: Beyond the Basics: Visualizing and Communicating Data

Advanced Spreadsheet Functions

1. Using logical functions: IF, AND, OR, IFERROR
2. Lookup and reference functions: VLOOKUP, HLOOKUP, INDEX, MATCH
3. Data aggregation techniques: SUMIFS, COUNTIFS, AVERAGEIFS
4. Text functions for data manipulation: TRIM, CLEAN, TEXT, RIGHT, LRFT, MID

Data Visualization Techniques

1. Creating various chart types: bar, line, pie, scatter
2. Advanced charting techniques: combo charts, dual-axis charts
3. Data visualization best practices: choosing the right chart, formatting, and styling
4. Creating and customizing PivotTables and Pivot Charts

Dashboard Creation

1. Introduction to dashboards: concepts and components
2. Using PivotTables and Pivot Charts for dashboard elements
3. Applying conditional formatting for dynamic visual cues
4. 4.Creating interactive dashboards with slicers and timeline

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VAC201	26YOGX04VA01	Yoga and Physical fitness	0L:0T:4P	2 Credits

Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

YOGA

Course Objective(s):

CO1: Understand yoga's significance and its practical applications for holistic well-being.
CO2: Explore subtle energy systems and their role in enhancing health through yogic practices.
CO3: Examine various paths of yoga to foster self-realization and spiritual growth.
CO4: Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.
CO5: Apply yogic principles to manage psycho-somatic ailments and promote resilience.

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 yaga, 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, dhyan, 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

Suggested Readings:

- 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.

VAC201	**26SPOX04VA02**	**Sports Management**	**0L:0T:4P**	**2 Credits**

SPORTS MANAGEMENT

Course Objective(s):

CO1: Understand the fundamental principles and concepts of sports management, including its scope, organizational structure, and ethical considerations.

CO2:Analyse the role of marketing and sponsorship in the sports industry, with a focus on branding, target audience segmentation, and event management.

CO3: Develop proficiency in financial management techniques specific to the sports industry, including revenue generation, cost management, and investment strategies.

CO4: Explore the application of analytics and technology in sports, including performance evaluation, strategic decision-making, and fan engagement.

CO5: Apply theoretical knowledge to practical scenarios through case studies and projects, fostering critical thinking and problem-solving skills in sports management contexts.

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 modelling, Key performance indicators (KPIs) in sports, Applications of analytics: talent scouting, injury prevention, performance optimization.

Suggested Readings :

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

VAC201 26NCCX04VA03 NATIONAL CADET CORPS 0L:0T:4P 02 Credits

NATIONAL CADET CORPS (NCC)

Course Objective(s):

CO1: Understand the foundational role of drill in fostering discipline and leadership within a group, enabling effective command towards achieving common goals.

CO2: Appreciate the importance of grace and dignity in executing foot drill movements, recognizing their significance in enhancing performance and teamwork.

CO3: Comprehend the criticality of weapon handling and detailed safety measures, emphasizing the importance of accident prevention through strict adherence to safety protocols.

CO4: 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.

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

Suggested Readings:

1. DGNCC Cadet's Hand Book - Common Subjects -All Wings
2. Tiwari, R. NCC: Grooming Feeling of National Integration, Leadership and Discipline among Youth. Edwin Incorporation.
3. Chhetri, R.S. Grooming Tomorrows Leaders, The National Cadet Corps.
4. Directorate General National Cadet Corps. National Cadet Corps, Youth in Action.
5. Vanshpal, Ravi. The NCC Days, Notion Press.

VAC201 26NSSX04VA04 NATIONAL SERVICE SCHEME 0L:0T:4P 02 Credits

NATIONAL SERVICE SCHEME (NSS)

Course Objective(s):

CO1: To provide students with an understanding of the history, philosophy, and basic concepts of the National Service Scheme (NSS).

CO2: To familiarize students with the aims, objectives, and organizational structure of NSS.

CO3: To equip students with knowledge about NSS programmes, activities, and their relevance.

CO4: To develop an understanding of community mobilization techniques and their importance in NSS activities.

CO5: To cultivate an appreciation for volunteerism, shramdan (voluntary labor), and their role in community development initiatives.

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 Swatch Bharat Abhiyan and Digital India

Suggested Readings:

1. Ministry of Youth Affairs and Sports, Government of India. National Service Scheme (NSS) Manual.
2. Agarwalla, S. NSS and Youth Development. Mahaveer Publications
3. Bhattacharya, P. Stories Of NSS (English Version). Sahityasree.
4. Borah, R. and Borkakoty, B. NSS in Socioeconomic Development. Unika Prakashan.
5. Wondimu, H., & Admas, G. 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.. Extension Education–The Third Dimension Needs and Aspirations of Indian Youth. *Journal of Social Sciences*, *6*(3), 209-214.
7. Mills, S. "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. Mukherji, B. Community Development in India. Orient Longmans.

VAC201 26DMTX04VA05 NATIONAL CADET CORPS 0L:0T:4P 02 Credits

DISASTER MANAGEMENT

Course Objectives:

CO1: to provide understanding of the concepts related to disaster

CO2: to highlight the importance and role of disaster management

CO3: to enhance awareness of institutional processes and management strategies to mitigate the impacts of disasters

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.**

Suggested Readings

1. Sharma, S.C. Disaster Management, Khanna Book Publishing.
2. Clements, B. W., Disasters and Public Health: Planning and Response, Elsevier Inc.
3. Dunkan, K., and Brebbia, C. A., (Eds.) Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes, WIT Press, UK.
4. Singh, R. B. (ed.),Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.
5. Ramkumar, Mu, Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Modh, S., Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.
7. Carter, N., 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., Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.

SEMESTER –IV

CC204	26BCA404DS01	Entrepreneurship and Startup Ecosystem	1L:1T:0P	2 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1: To understand Entrepreneurship and its types

CO2: To understand that not all ideas can be turned into viable business models and estimate business potential of an idea

CO3: To understand different type of finances available and financing methods

CO4: To be able to draft business plans on an identified idea

CO5: To understand the nuances of operating a startup – low budget marketing, stabilizing operations, build a team from scratch and scaling the business

CO6: To know what is a Family Business and how is it different from Entrepreneurship

Unit – I

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 – II

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 – III

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 – IV

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.

Suggested Readings:

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. Mapping the Startup Ecosystem in India, Anish Tiwari ,*Economic& Political Weekly*
6. Indian Family Businesses: Their survival beyond three generations, Ramachandran, K, ISB Working Paper Series

Note: Latest and additional good books may be suggested and added from time to time.

CC205	26BCA404DS02	Computer Networks	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

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.

Unit – I

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 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: 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 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.

Suggested Readings:

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

Pearson.
3. Gill, Nasib Singh, “Essentials of Computer and Network Technology”, ISBN: 81-87522-71-2 Pages: 340 Khanna Book Publishing Co. (P) Ltd, New Delhi.
4. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education.
5. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann.
6. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House.
7. Mastering PC Hardware & Networking, Khanna Publishing House.

Note: Latest and additional good books may be suggested and added from time to time.

Lab Programs

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

***Any other Programs/Lab Assignments given by the teachers.**

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CC206	26BCA404DS03	Design and Analysis of Algorithms	3L:0T:0P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1:To impart to students the understanding of basic algorithm designing paradigms.

CO2:To introduce the basic knowledge on how to analyse an algorithm.

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

Unit – I

Introduction: 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.

Suggested Readings:

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.
3. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd.
4. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson.
5. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston.
6. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education.

Note: Latest and additional good books may be suggested and added from time to time.

CC207	26BCA404DS04	Artificial Intelligence	3L:0T:4P	5 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

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

Unit – I

Introduction to Al: Introduction, 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.

Suggested Readings:

1. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, (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 .
4. Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company.

5. Russell, S. and Norvig, P., “Artificial Intelligence - A Modern Approach”, 3rd edition, Prentice Hall
6. Van Hirtum, A. & Kolski, C. Constraint Satisfaction Problems: Algorithms and Applications. Springer

Note: Latest and additional good books may be suggested and added from time to time.

Lab Assignments

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.

***Any other Programs/Lab Assignments given by the teachers.**

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DSE202	26BCA404DSE11	Data Visualization	1L:0T:4P	3 Credits

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives

CO1:Understand the fundamentals of data visualization and its importance.
CO2:Learn about visual perception and its impact on data interpretation.
CO3:Explore the ethical considerations and challenges in data visualization.
CO4:Study different types of visualizations and their appropriate uses.
CO5:Utilize Power BI to create and customize various types of visualizations.

Unit – I

Introduction to Data Visualization: Definition and importance of data visualization, Role of data visualization in decision making, Types of data (numerical, categorical, temporal, geographical)-Data visualization process (data collection, exploration, analysis, visualization, interpretation)-Challenges and limitations of data visualization

Unit – II

Visualization tools: Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)-Comparing and contrasting features and Use Cases among these tools.

Unit – III

Data Storytelling: Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity

Unit – IV

Designing Effective Visualizations: Principles of Good Visualization Design. Understanding and Using different tools like Color in Visualizations. Importance of Data Modelling in Visualization.

Suggested Readings:

1. Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, Wiley, 1st edition.
2. The Visual Display of Quantitative Information, Edward Tufte, Graphics Press USA, 2nd edition.
3. Data Visualization: A Practical Introduction, Kieran Healy, Princeton University Press.
4. Analyzing Data with Power BI and Power Pivot for Excel, Alberto Ferrari and Marco Russo, Microsoft Press, 1st edition.
5. Microsoft Power BI Complete Reference, Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition.

Note: Latest and additional good books may be suggested and added from time to time.

Web Resources

1. https://learn.microsoft.com/en-us/power-bi/
2. https://www.storytellingwithdata.com/
3. https://jpsm.umd.edu/sites/jpsm.umd.edu/files/syllabi/Syllabus_Introduction%20to%20Data%20Visualization_Spring%202024.pdf

Lab Programs for Data Visualization Using Power BI

Introduction to Power BI Interface and Basics

1. Installation and interface overview
2. Exploring the Power BI workspace: Ribbon, panes, and canvas.
3. Importing data from Excel and CSV files.
4. Introduction to multiple data sources
5. Basic report creation: Adding visuals and saving a report.

Data Transformation and Preparation

1. Using Power Query Editor
2. Cleaning data: Removing duplicates, handling missing values.
3. Transforming data: Splitting columns, changing data types, renaming columns.
4. Merging and appending queries.
5. Creating custom columns and calculated columns

Data Modelling

1. Creating relationships between tables
2. Identifying and resolving data inconsistencies
3. Creating calculated columns and measures

Creating Basic Visualizations

1. Creating various chart types (bar, column, line, pie, area, etc.,)
2. Formatting and customizing visualizations

Publishing and Sharing Reports

1. Publishing a report to Power BI Service.
2. Sharing reports and dashboards with team members.
3. Setting up data refresh schedules and managing permissions.

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SEC 202	**26BCA404SEC01**	**Design Thinking and Innovation**	**1L:1T:0P**	**2 Credits**

Note: The examiner has to set nine questions in all by setting two questions from each Unit and Question No. 1 consisting of short-answer questions covering the entire syllabus. Students must attempt five questions in all by selecting one question from each Unit and Question No. 1, which is compulsory. All questions will carry equal marks.

Course Objectives:

CO1: Introduce students to design-based thinking approach to solve problems
CO2: Observe and assimilate unstructured information to well framed solvable problems
CO3: Introduce student to templates of ideation
CO4: Understand the importance of prototyping in the innovation journey
CO5: Implementing innovation projects

Unit – I
Basics of Design Thinking: Understand the concept of innovation and its significance in business, Understanding creative thinking process and problem solving approaches, Know Design Thinking approach and its objective, 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. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement
Unit – II
Learning to Empathize and Define the Problem: Know the importance of empathy in innovation process – how can students develop empathy using design tools, Observing and assimilating information, Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences, Identifying wicked problems around us and the potential impact of their solutions.
Unit – III
Ideate, Prototype and Implement: Know the various templates of ideation like brainstorming, systems thinking, Concept of brainstorming – how to reach consensus on wicked problems, Mapping customer experience for ideation, Know the methods of prototyping, purpose of rapid prototyping. Implementation.
Unit – IV
Feedback, Re-Design & Re-Create: Feedback loop, focus on User Experience, address ergonomic challenges, user focused design, Final concept testing, Final Presentation – Solving Problems through innovative design concepts & creative solution.
Suggested Readings: 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 4. Design Thinking by Nigel Cross, Bloomsbury. **Note:** Latest and additional good books may be suggested and added from time to time.

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