

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES- BASED CURRICULUM FRAMEWORK

B.Sc.Computer Science (Data Science and Analytics)

Those who have joined in the Academic year 2023-24 onwards

1. Introduction

B.Sc. Computer Science (Data Science and Analytics)

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Learning Outcomes-based Curriculum Framework (LOCF) which makes it student- centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the state which will help the students to ensure similar quality of education irrespective of the institute and location.

Computer Science is the study of quantity, structure, space and change, focusing on problem solving, application development with wider scope of application in science, engineering, technology, social sciences etc. throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Computer science is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Nowadays, practically everyone is a computer user, and many people are even computer programmers. Computer Science can be seen on a higher level, as a science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of computer science also has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular application domain. Computer science has a wide range of specialties. These include Computer Architecture, Software Systems, Graphics,

Artificial Intelligence, Computational Science, and Software Engineering. Drawing from a common core of computer science knowledge, each specialty area focuses on specific challenges. Computer Science is practiced by mathematicians, scientists and engineers. Mathematics, the origins of Computer Science, provides reason and logic. Science provides the methodology for learning and refinement. Engineering provides

the techniques for building hardware and software.

Programme Outcome, Programme Specific Outcome and Course Outcome

Computer Science is the study of quantity, structure, space and change, focusing on problem solving, application development with wider scope of application in science, engineering, technology, social sciences etc. The key core areas of study in Mathematics include Algebra, Analysis (Real & Complex), Differential Equations, Geometry, and Mechanics. The

Students completing this programme will be able to present Software application clearly and precisely, make abstract ideas precise by formulating them in the Computer languages. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in software industry, banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

2. Programme Outcomes (PO) of B.Sc.degree programme in Computer Science(DataScience and Analytics)

- Scientific aptitude will be developed in Students
- Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the Computer Science & humanities stream.
- Students will become employable; Students will be eligible for career opportunities in education field, Industry, or will be able to opt for entrepreneurship.
- Students will possess basic subject knowledge required for higher studies, professional and applied courses.
- Students will be aware of and able to develop solution oriented approach towards various Social and Environmental issues.
- Ability to acquire in-depth knowledge of several branches of Computer Science and aligned areas. This Programme helps learners in building a solid foundation for higher studies in Computer Science and applications.
- The skills and knowledge gained leads to proficiency in analytical reasoning, which can be utilized in modelling and solving real life problems.
- Utilize computer programming skills to solve theoretical and applied problems by critical understanding, analysis and synthesis.
- To recognize patterns and to identify essential and relevant aspects of problems.
- Ability to share ideas and insights while seeking and benefitting from knowledge and insight of others.
- Mould the students into responsible citizens in a rapidly changing interdependent society.

The above expectations generally can be pooled into 6 broad categories and can be modified according to institutional requirements:

- PO1: Knowledge
- PO2: Problem Analysis
- PO3: Design / Development of Solutions
- PO4: Conduct investigations of complex problems
- PO5: Modern tool usage
- PO6: Applying to society

3. Programme Specific Outcomes of B.Sc. Degree Programme in Computer Science(Data Science and Analytics)

- PSO1: Think in a critical and logical based manner
- PSO2: Familiarize the students with suitable software tools of computer science and industrial applications to handle issues and solve problems in mathematics or statistics and real-time application related sciences.
- PSO3: Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
- PSO4: Understand, formulate, develop programming model with logical approaches to a Address issues arising in social science, business and other contexts.
- PSO5: Acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Computer science and Industrial statistics.
- PO6: Provide students/learners sufficient knowledge and skills enabling them to undertake further studies in Computer Science or Applications or Information Technology and its allied areas on multiple disciplines linked with Computer Science.
- PO7: Equip with Computer science technical ability, problem solving skills, creative talent and power of communication necessary for various forms of employment.
- PO8: Develop a range of generic skills helpful in employment, internships& societal activities.
- PO9: Get adequate exposure to global and local concerns that provides platform for further exploration into multi-dimensional aspects of Computing sciences.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) can be carried out accordingly, assigning the appropriate level in the grids: (put tick mark in each row)

	POs							PSOs		
	1	2	3	4	5	6	...	1	2	...
CLO1										
CLO2										
CLO3										
CLO4										
CLO5										
CLO6										
...										

**CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-
BASED CURRICULUM FRAMEWORK**

B.Sc Computer Science (Data Science and Analytics)

Part	Courses	Subject	Code	Cr.	Hrs
SEMESTER - I					
I	Lang. – I	nghJj;jkpo; - I	230103101	3	6
II	Lang. - II	General English	231003101	3	4
III	CC – 1	Programming in C	235603101	4	4
	CC – 2	Programming in C Lab	235603102	4	6
	EC – I [Any One]	Discrete Mathematical Structure	235603103	3	4
IV	SEC –I (NME)	Office Automation	234603156	2	2
IV	FC	Problem Solving Techniques	234403156	2	2
	AECC – 1	Soft Skill - I	236003101	2	2
	Total			23	30
SEMESTER II					
I	Lang. -I	nghJj;jkpo; - II	230103201	3	6
II	Lang. -II	General English	231003201	3	4
III	CC – 3	Data Structure and Algorithms	235603201	4	4
	CC - 4	Data Structure and Algorithms Lab with C/C++	235603202	4	6
	EC – II [Any One]	Numerical Methods	235603203	3	4
IV	SEC –II (NME)	Quantitative Aptitude	234603256	2	2
	SEC - III	Digital Computers Fundamentals	234403256	2	2
	AECC –II	Soft Skill - II	236003201	2	2
				23	30
SEMESTER III					
I	Lang. -I	nghJj;jkpo; - III	230103301	3	6
II	Lang. -II	General English	231003301	3	4
III	CC – 5	Python Programming	235603301	4	4
	CC - 6	Python Programming Lab	235603302	4	6
	EC –3	Probability and Statistics	235603303	3	4
IV	SEC –IV	PHP Programming Lab	234403356	1	1
	SEC – V	Advanced Excel	238203356	2	2
	AECC – III	Soft Skill - 3	236003301	2	2
	EVS	Environmental Studies	234103301	1	1
				23	30

Part	Courses		Code	Cr.	Hrs
SEMESTER IV					
I	Lang. – I	nghJj;jkpo; - IV	230103101	3	6
II	Lang. - II	General English	231003101	3	4
III	CC – 7	Java Programming	235603401	4	4
	CC - 8	Java Programming Lab	235603402	4	5
	EC – IV	Database Management Systems	235603403	3	4
IV	SEC –VI	Database Management Systems Lab	234403456	2	2
IV	SEC –VII	Resource Management Techniques	238203456	2	2
	AECC- IV	Soft Skill - IV	236003301	2	2
	EVS	Environmental Studies	234103401	1	1
	Total			24	30
SEMESTER V					
III	CC – 9	Software Engineering	235603501	4	5
	CC - 10	Data Preparation and Visualization	235603502	4	5
	CC - 11	Data Preparation and Visualization Lab	235603503	4	5
	Core 12	Project with Viva voce	235603504	4	4
	EC – V	Introduction to Data Science	235603505	3	5
	EC – VI	Data Mining and Warehousing	235603507	3	5
IV		Value Education	234303501	1	1
		Internship/Industrial Training(carried out in II year summer vacation)30 hrs	235603509	2	
				25	30
SEMESTER VI					
III	CC – 13	Computer Networks	235603601	4	5
	CC – 14	Big Data Analytics	235603602	4	5
	CC – 15	Business Analytics Programming Lab using R and Tableau	235603603	4	5
	EC –7	Machine Learning	235603604	3	5
	EC - 8	Machine Learning Lab	235603606	3	5
IV	Professional competency skill enhancement course	Quantitative Aptitude	235603608	2	4
		Value Education	234303601	1	1
V		Extension Activity (outside college hrs)	235603609	1	
				22	30

Title of the Course		Programming in C						
Part		III						
Category	Core	Year	I	Credits	4	Course Code	235603101	
		Semester	I					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		4	-	--	4	25	75	100
Pre-requisite		Basic Knowledge of Programming concept						
Learning Objectives								
✍ To gain knowledge in C language.								
✍ To inculcate fundamental programming skills.								
UNIT	Details							No. of Periods for the Unit
I	Overview of C: Importance of C, sample C program, C program structure, executing C program. Constants, Variables, and Data Types: Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, Assigning values to variables--- Assignment statement, declaring a variable as constant, as volatile. Operators and Expression: Arithmetic, Relational, logical, assignment, increment, decrement, conditional, bitwise and special operators, arithmetic expressions, operator precedence, type conversions, mathematical functions Managing Input and Output Operators: Reading and writing a character, formatted input, formatted output.							12
II	Decision Making and Branching: Decision making with If, simple IF, IF ELSE, nested IF ELSE , ELSE IF ladder, switch, GOTO statement.Decision Making and Looping: While, Do- While, For, Jumps in loops.							12
III	Arrays: Declaration and accessing of one & two-dimensional arrays, initializing two-dimensional arrays, multidimensional arrays. Functions: The form of C functions, Return values and types, calling a function, categories of functions, Nested functions, Recursion, functions with arrays, call by value, call by reference, storage classes-character arrays and string functions.							12
IV	Structures and Unions: Defining, giving values to members, initialization and comparison of structure variables, arrays of structure, arrays within structures, structures within structures, structures and functions, unions. Preprocessors: Macro substitution, file inclusion.							12
V	Pointers: definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor, pointers and arrays, pointers and functions, pointers and structures. File Management in C: Opening, closing and I/O operations on files, random access to files, command line arguments.							12

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Remember the program structure of C with its syntax and semantics
CO2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)
CO3	Apply the programming principles learnt in real-time problems
CO4	Analyze the various methods of solving a problem and choose the best method
CO5	Code, debug and test the programs with appropriate test cases

Text Books (Latest Editions)	
1.	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Byron Gottfried, Schaum’s Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.
2.	Kernighan and Ritchie, The C Programming Language, Second Edition, PrenticeHall, 1998.

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	S
CO5	S	S	M	S	S	S	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Programming in C Lab						
Part		III						
Category	Core	Year	I	Credits	4	Course Code	235603102	
		Semester	I					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		-	-	6	6	25	75	100
Pre-requisite		Basic Knowledge of Programming concept						
Learning Objectives								
✍ To implement programming skills using C								
✍ To impart knowledge and provide efficient solutions for real time problems using C language								
UNIT	Details							No. of Periods for the Unit
Variables, Data types, Constants and Operators								
1. Evaluation of expression ex: $((x+y)^2 * (x+z))/w$								
2. Temperature conversion problem (Fahrenheit toCelsius)								
3. Program to convert days to months and days (Ex: 364days = 12 months and 4 days)								
4. Solution of quadratic equation								
5. Salesman salary (Given: Basic Salary, Bonus for every item sold, commission on the total monthlysales)								
Decision making Statements								
6. Maximum of three numbers								
7. Calculate Square root of five numbers (using gotostatement)								
8. Pay-Bill Calculation for different levels of employee(Switch statement)								
9. Fibonacci series								
Floyds Triangle 11.Pascal's Triangle								
Arrays, Functions and Strings								
12. Prime numbers in an array								
13. Sorting data (Ascending and Descending)								
14. Matrix Addition and Subtraction								
15. Matrix Multiplication								
16.Function with no arguments and no return values								
17. Function that convert lower case letters to uppercase								
18. Factorial using recursion.								
19. Perform String Operations using Switch Case.								
Structures and Macros								
20. Structure that describes a Hotel (name, address,grade,avg room rent, number of rooms) Perform some operations (list of hotels of a given grade etc.)								
21. Using Pointers in Structures.								
22. Cricket team details using Union.								
23. Write a macro that calculates the max and min of twonumbers								
24. Nested macro to calculate Cube of a number.								
Pointers and Files								
25. Evaluation of Pointer expressions								
26.Function to exchange two pointer values								
27. Creation, insertion and deletion in a linked list								
28.Program to read a file and print the data.								
29. Program to receive a file name and a line of text ascommand line arguments and write the text to the file								
30. Program to copy the content of one file to anotherfile.								

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Remember and understand how to write programs using the basic syntax and semantics in C
CO2	Apply the concepts of functions, macros, arrays, structures, pointers and files in programsto solve problems
CO3	Analyze and understand programs written in C language
CO4	Evaluate the program execution flow with test cases and apply debugging
CO5	Design algorithms and write programs in C language for the given problems

Text Books (Latest Editions)	
1.	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill,2010.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Byron Gottfried, Schaum"s Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.
2	Kernighan and Ritchie, The C Programming Language, Second Edition, PrenticeHall, 1998.
3	YashavantKanetkar, Let Us C, Eighteenth Edition, BPB Publications, 2021
Web Resources	
1.	Web resources from NDL Library, E-content from open-sourcelibraries

Title of the Course		Discrete Mathematical Structures						
Part		III						
Category	EC I	Year	I	Credits	3	Course Code	235603103	
		Semester	I					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		4	-	--	4	25	75	100
Pre-requisite		Basic Knowledge on probability and mathematical logic						
Learning Objectives								
✍ To understand the mathematical concepts like set theory, logics, number theory, combinatory and relations.								
UNIT	Details							No. of Periods for the Unit
I	SET THEORY - Introduction- set and Its Element – Set Description (Roster, Set Builder and cardinal number method) Types of Sets- Set Operations and Laws of set Theory. Partition of sets. Minsets-Countable and un Countable set. Algebra of sets and Duality							12
II	MATHEMATICAL LOGIC - Basic Logic and Proof, logical operations – Logic Propositional equivalence, Predicates and Quantities, Tautology-Contradiction-Methods of proofs(Direct and Indirect)- Function- Definition-Notation- Types of Function- Composition of Functions-							12
III	NUMBER THEORY - The Integers and Division, Integers and Algorithms,(Multiplication, Addition and Division - Sequences and Summations, Recursive algorithms, Program correctness.							12
IV	MATRICES – Matrix Arithmetic – Algorithms for Matrix Multiplication – Transposes and Power of Matrices – Zero – One Matrices – Boolean Product.							12
V	RELATIONS - Relations – Relations and their properties, Representing Relations, Closures of relations, Equivalence relations, Partial orderings-Recurrence Relations Binary Relations.							12

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	To gain knowledge on set theory.
CO2	Able to understand different mathematical logics and functions.
CO3	Understanding the different form of number theory.
CO4	To get an idea on Matrices and Boolean Product.
CO5	Able to understand Relations and its applications.

Text Books (Latest Editions)	
1.	Rosen K.H. Discrete Mathematics and its Applications, 5 th edition, Tata McGraw – Hills,2003.
2.	J.K Sharma “DISCRETE MATHEMATICS”3 rd Edition MacmillanReprint2011

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Johnson Baugh R, and Carman R, Discrete mathematics, 5 th edition, Person Education, 2003.
2	Kolman B, Busoy R.C, and Ross S.C, Discrete Mathematical Structures, 5th edition, Pretitice – Hall,2004.
3	Mott J.L, Kandel A, and Bake T.P, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd edition, Prentice-Hall ofIndia,2002.
Web Resources	
1.	Web resources from NDL Library, E-content from open-sourcelibraries

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	S	M	S	S
CO2	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	M	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Office Automation						
Part		IV						
Category	NME	Year	I	Credits	2	Course Code	234603156	
		Semester	I					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		2	-	--	2	25	75	100
Pre-requisite		Basic skills in Computer operations						
Learning Objectives								
<p>✍ The major objective in introducing the Computer Skills course is to impart training for students in Microsoft Office which has different components likeMS Word, MS Excel and Power point.</p> <p>✍ The course is highly practice oriented rather than regular classroom teaching.</p> <p>✍ To acquire knowledge on editor, spread sheet and presentation software</p>								
UNIT	Details							No. of Periods for the Unit
I	Introductory concepts: Memory unit– CPU-Input Devices: Key board, Mouse and Scanner. Output devices: Monitor, Printer. Introduction to Operating systems & its features: DOS– UNIX– Windows. Introduction to Programming Languages							6
II	Word Processing: Open, Save and close word document; Editing text – tools, formatting, bullets; Spell Checker - Document formatting – Paragraph alignment, indentation, headers and Footers, numbering; printing–Preview, options, merge.							6
III	Spreadsheets: Excel– opening, entering text and data, formatting, navigating; Formulas– entering, handling and copying; Charts– creating, formatting and printing, analysis tables, preparation of financial statements, introduction to data analytics.							6
IV	Database Concepts: The concept of data base management system; Data field, records, and files, Sorting and indexing data; Searching records. Designing queries, and reports; Linking of data files; Understanding Programming environment in DBMS; Developing menu drive applications inquiry language (MS–Access).							6
V	Power point: Introduction to Power point - Features – Understanding slide typecasting & viewing slides – creating slide shows. Applying special object – including objects & pictures – Slide transition–Animation effects, audio inclusion, timers.							6

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Understand the basics of computer systems and its components.
CO2	Understand and apply the basic concepts of a word processing package.
CO3	Understand and apply the basic concepts of electronic spread sheet software.
CO4	Understand and apply the basic concepts of data base management system.
CO5	Understand and create a presentation using Power Point tool

Text Books (Latest Editions)	
1.	Peter Norton, “Introduction to Computers”–Tata McGraw-Hill.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Jennifer Ackerman Kettel, Guy Hat-Davis, Curt Simmons, “Microsoft2003”, TataMcGraw-Hill.
Web Resources	
1.	Web resources from NDL Library, E-content from open-sourcelibraries

Mapping with Programme Outcomes:									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	S	M	S	S
CO2	S	M	S	S	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:					
CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		PROBLEM SOLVING TECHNIQUES						
Part		IV						
Category	FC	Year	I	Credits	2	Course Code		234403156
		Semester	I					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		2	-	--	2	25	75	100
Pre-requisite		Basic of Problem-solving skills						
Learning Objectives:								
✍ To understand the importance of algorithms and programs, and to know of the basic problem solving strategies.								
✍ To learn efficient strategies and algorithms to solve standard problems, thus laying a firm foundation for designing algorithmic solutions to problems.								
Units	Details							No. of Periods for the Unit
I	Introduction:Notion of algorithms and programs – Requirements for solving problems by computer – The problem-solving aspect: Problem definition phase, Getting started on a problem, The use of specific examples, Similarities among problems, Working backwards from the solution – General problem-solving strategies - Problem solving using top-down design – Implementation of algorithms – The concept of Recursion.							6
II	Fundamental Algorithms: Exchanging the values of two variables – Counting - Summation of a set of numbers - Factorial computation - Sine function computation - Fibonacci Series generation - Reversing the digits of an integer – Base Conversion.							6
III	Factoring Methods: Finding the square root of a number – The smallest divisor of an integer – Greatest common divisor of two integers - Generating prime numbers – Computing the prime factors of an integer – Generation of pseudo-random numbers - Raising a number to a large power – Computing the <i>n</i> th Fibonacci number.							6
IV	Array Techniques: Array order reversal – Array counting or histogramming – Finding the maximum number in a set - Removal of duplicates from an ordered array - Partitioning an array – Finding the <i>k</i> th smallest element – Longest monotone subsequence.							6
V	Text Processing and Pattern Searching: Text line length adjustment – Left and right justification of text – Keyword searching in text – Text line editing – Linear pattern search. Recursive algorithms: Towers of Hanoi – Permutation generation.							6
Course Outcomes								
Course Outcomes	On completion of this course, students will;							
CO1	Understand the systematic approach to problem solving.							PO1
CO2	Know the approach and algorithms to solve specific fundamental problems.							PO1, PO2
CO3	Understand the efficient approach to solve specific factoring-related problems.							PO4, PO6
CO4	Understand the efficient array-related techniques to solve specific problems.							PO4, PO5, PO6
CO5	Understand the efficient methods to solve specific problems related to text processing. Understand how recursion works.							PO3, PO6

Text Books (Latest Editions)	
1	R. G. Dromey, <i>How to Solve it by Computer</i> , Pearson India, 2007.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	George Polya, Jeremy Kilpatrick, <i>The Stanford Mathematics Problem Book: With Hints and Solutions</i> , Dover Publications, 2009 (Kindle Edition 2013).
2	Greg W. Scragg, <i>Problem Solving with Computers</i> , Jones & Bartlett 1st edition, 1996.
Web Resources	
	Web content from NDL / SWAYAM or open source web resources

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	M	S	S	M
CO2	S	S	S	S	M	S	S	M	S
CO3	S	M	S	S	S	S	M	S	S
CO4	M	S	S	M	S	S	S	S	M
CO5	S	S	S	S	S	S	M	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	APSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Data Structure and Algorithms						
Part		III						
Category	Core	Year	I	Credits	4	Course Code		235603201
		Semester	II					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		4	-	--	4	25	75	100
Pre-requisite		Basic knowledge in data and representations						
Learning Objectives:								
<p>✍ To impart the basic concepts of data structures and algorithms.</p> <p>✍ To acquaint the student with the basics of the various data structures and make the students knowledgeable in the area of data structures.</p> <p>✍ This course also gives insight into the various algorithm design techniques .</p>								
Units	Details							No. of Periods for the Unit
I	INTRODUCTION TO DATA STRUCTURES: Data Structures: Definition- Time & Space Complexity,Arrays: Representation of arrays, Applications of arrays, sparse matrix and its representation.Linear list: Singly linked list implementation, insertion, deletion and searching operations on linear list . Circular linked list: implementation, Double linked list implementation, insertion, deletion and searching operations. Applications of linked lists- Dynamic Storage management.							
II	STACKS: Operations, array and linked representations of stack, stack applications, infix to postfix conversion, postfix expression evaluation, recursion implementation.							
III	QUEUES, TREES & GRAPHS: Queues: operations on queues, array and linked representations.Circular Queue: operations,, applications of queues.Trees: Definitions and Concepts- Representation of binary tree, Binary tree traversals (Inorder, Postorder , preorder), Binary search trees Graphs : Representation of Graphs- Types of graphs -Breadth first traversal – Depth first traversal- -Applications of graphs .							
IV	INTRODUCTION TO ALGORITHMS: INTRODUCTION: Definition of Algorithms- Overview and importance of algorithms- pseudocode conventions, Asymptotic notations, practical complexities.Divide-and-Conquer: : General Method – Binary Search-Quick Sort- Merge Sort.Greedy Method: General method- Knapsack problem- Tree vertex splitting- Job sequencing with deadlines.							
V	DYNAMIC PROGRAMMING, BACKTRACKING & BRANCH &BOUND : Dynamic programming: General method, Multistage Graphs, All pairs shortest path, Single source shortest path.Backtracking: General method, 8 Queens, Graph coloring, Hamiltonian cycle. Branch & Bound: General method, Travellingsalesperson problem.							
Course Outcomes								
Course Outcomes	On completion of this course, students will;							
CO1	To introduce the concepts of Data structures and to understand simple linear datastructures.							
CO2	Learn the basics of stack data structure, its implementation and application.							

CO3	Use the appropriate data structure in context of solution of given problem and demonstrate familiarity with major data structures.	
CO4	To introduce the basic concepts of algorithms	
CO5	To give clear idea on algorithmic design paradigms like Dynamic Programming, Backtracking, Branch and Bound	

Text Books (Latest Editions)	
1	Ellis Horowitz , Sartaj Sahni, Susan Anderson Freed, Second Edition , “Fundamentals of Data Structures in C”, Universities Press
2	E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition , “Fundamentals of Computer Algorithms “ Universities Press
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Seymour Lipschutz ,”Data Structures with C”, First Edition, Schaum’s outlines series in computers, Tata McGraw Hill.
2	R.Krishnamoorthy and G.Indirani Kumaravel, Data Structures using C, Tata McGrawHill – 2008.
3	A.K.Sharma, Data Structures using C , Pearson Education India, 2011.
4	G. Brassard and P. Bratley, “Fundamentals of Algorithms”, PHI, New Delhi, 1997.
5	A.V. Aho, J.E. Hopcroft, J.D. Ullmann,, “The design and analysis of Computer Algorithms”, Addison Wesley, Boston, 1974
6	Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009
7	Sanjoy Dasgupta, C. Papadimitriou and U. Vazirani , Algorithms , Tata McGraw-Hill, 2008.
Web Resources	
	Web resources from NDL Library, E-content from open-source libraries





Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	M	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S
CO4	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Data Structure and Algorithms Lab with C/C++						
Part		III						
Category	Core	Year	I	Credits	4	Course Code	235603202	
		Semester	II					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		-	1	5	6	25	75	100
Pre-requisite		Basic skills in problem solving						
Learning Objectives:								
<div><div></div> To understand and implement basic data structures using C</div> <div><div></div> To apply linear and non-linear data structures in problem solving.</div> <div><div></div> To learn to implement functions and recursive functions by means of data structures</div> <div><div></div> To implement searching and sorting algorithms</div>								
Units	List of Exercises							
	<div><div>1.</div> Array implementation of stacks</div> <div><div>2.</div> Array implementation of Queues</div> <div><div>3.</div> Linked list implementation of stacks</div> <div><div>4.</div> Linked list implementation of Queues</div> <div><div>5.</div> Binary Tree Traversals (Inorder, Preorder, Postorder)</div> <div><div>6.</div> Implementation of Linear search and binary search</div> <div><div>7.</div> Implementation Insertion sort, Quick sort andMerge Sort</div> <div><div>8.</div> Implementation of Depth-First Search & Breadth-First Search of Graphs.</div> <div><div>9.</div> Finding all pairs of Shortest Path of a Graph.</div> <div><div>10.</div> Finding single source shortest path of a Graph.</div>							
Course Outcomes								
Course Outcomes	On completion of this course, students will;							
CO1	Implement data structures using C							
CO2	Implement various types of linked lists and their applications							
CO3	Implement Tree Traversals							
CO4	Implement various algorithms in C							
CO5	Implement different sorting and searching algorithms							

Text Books (Latest Editions)	
1	Ellis Horowitz , SartajSahni, Susan Anderson Freed, Second Edition , “Fundamentals of Data in C”, Universities Press
2	E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition , “Fundamentals of Computer Algorithms “ Universities Press
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Seymour Lipschutz ,”Data Structures with C”, First Edition, Schaum“s outlineseries in computers, Tata McGraw Hill.
2	R.Krishnamoorthy and G.IndiraniKumaravel, Data Structures using C, Tata McGrawHill – 2008.
3	A.K.Sharma, Data Structures using C , Pearson Education India,2011.
4	G. Brassard and P. Bratley, “Fundamentals of Algorithms”, PHI, New Delhi, 1997.
5	A.V. Aho, J.E. Hopcroft, J.D. Ullmann,, “The design and analysis of Computer Algorithms”, Addison Wesley, Boston, 1974

6	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009
7	SanjoyDasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2008.
Web Resources	
	Web resources from NDL Library, E-content from open sourcelibraries

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	M	S	S	S	S	M	S
CO2	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	M	S	S	S
CO4	S	S	S	M	S	S	S	S	M
CO5	S	S	M	S	S	S	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Numerical Methods						
Part		III						
Category	EC - II	Year	I	Credits	3	Course Code		235603203
		Semester	II					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		4	-	4	4	25	75	100
Pre-requisite		Basic Knowledge of mathematics						
Learning Objectives:								
<div>✍ To introduce the various topics in Numerical methods.</div> <div>✍ To make understand the fundamentals of algebraic equations.</div> <div>✍ To apply interpolation and approximation on examples.</div> <div>✍ To solve problems using numerical differentiation and integration.</div> <div>✍ To solve linear systems, numerical solution of ordinary differential equations.</div>								
Units	List of Exercises							
I	FUNDAMENTALS OF ALGEBRAIC EQUATION: Solution of algebraic and transcendental equations-Bisection method – Fixed point iteration method – Newton Raphson method –linear system of equations – Gauss elimination method – Gauss Jordan method .							
II	Iterative, InterpolationAnd Approximation: Iterative methods - Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi’s method for symmetric matrices. Interpolation with unequal intervals – Lagrange’s interpolation – Newton’s divided difference interpolation							
III	INTERPOLATION WITH EQUAL INTERVAL: Difference operators and relations. -Interpolation with equal intervals – Newton’s forward and backward difference formulae.							
IV	NUMERICAL DIFFERENTIATION AND INTEGRATION: Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson’s 1/3 rule.							
V	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS: Single step methods – Taylor’s series method – Euler’s method – Modified Euler’smethod - RungeKutta method for solving(first, second , Third and 4th) order equations – Multi step methods							
Course Outcomes								
Course Outcomes	On completion of this course, students will;							
CO1	Know how to solve various problems on numerical methods							
CO2	Use approximation to solve problems							
CO3	Differentiation and integration concept are applied							
CO4	Apply , direct methods for solving linear systems							
CO5	Numerical solution of ordinary differential equations							

Text Books (Latest Editions)	
1	Numerical Methods, Second Edition, S.Arumugam, A.ThangapandiIssac, A.Somasundaram, SCITECH publications, 2009.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1	Mathews J.H. Numerical Method for Maths, Science and Engineering; PHI, New Delhi, 2001.

2	Iqbal H. Khan & Q. Hassan Numerical Methods for Engineers and Scientist - Galgotia Publications (P) Ltd., New Delhi – 1997.
3	M.K. Jain, S.R.K. Iyengar & R.K. Jain - Numerical Methods for Scientific and Engineering Computation - New Age International (P) Ltd., New Delhi – 1996.
Web Resources	
	Web resources from NDL Library, E-content from open source libraries

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	M	S	S	S
CO2	M	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	M	S	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Quantitative Aptitude						
Part		IV						
Category	SEC – II NME	Year	I	Credits	2	Course Code	234603256	
		Semester	II					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		2	-	2	2	25	75	100
Pre-requisite		Basic knowledge in numerical ability						
Learning Objectives:								
✍ To improve the quantitative skill soft he students								
✍ To prepare the students for various competitive exams								
Units	List of Exercises							
I	Numbers-HCF and LCM of numbers Decimal fractions-Simplification- Square roots and cube roots-Average-Problems on Numbers							
II	Problems on Ages - Surds and Indices - percentage - profits and loss - ratio and proportion-partnership-Chain rule.							
III	Time and work - pipes and cisterns - Time and Distance - problems on trains -Boats and streams - simple interest - compound interest -Logarithms - Area –Volume and surface area- Races and Games of skill.							
IV	Permutation and combination-probability- True Discount-Bankers Discount Height and Distances-Odd man out & Series.							
V	Calendar - Clocks - stocks and shares - Data representation - Tabulation – Bar Graphs-Piecharts-Line graphs							
Course Outcomes								
Course Outcomes	On completion of this course, students will;							
CO1	To gain knowledge on LCM and HCF and its related problems							
CO2	To get an idea of age, profit and loss related problem solving.							
CO3	Able to understand time series simple and compound interests							
CO4	Understanding the problem related to probability, and series							
CO5	Able to understand graphs, charts							

Text Books (Latest Editions)	
1	“Quantitative Aptitude”, R.S .AGGARWAL.,S. Chand&Company Ltd.,
Web Resources	
	Authentic Web resources related to Competitive examinations

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S
CO4	S	M	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3

Title of the Course		Digital Computers Fundamentals						
Part		IV						
Category	SEC – III	Year	I	Credits	2	Course Code	234403256	
		Semester	II					
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	CIA	External	Total
		2	-	2	2	25	75	100
Pre-requisite		Basic Mathematics						
Learning Objectives:								
✍ ItaimstotrainthestudenttothebasicconceptsofDigitalComputerFundamentals								
✍ To impart the in-depth knowledge of logic gates, Boolean algebra, combinational circuits and sequential circuits.								
Units	List of Exercises							
I	Number Systems and Codes: Number System– Base Conversion – Binary Codes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – UniversalGates.							
II	Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification of Boolean Functions–Using Theorems, K- Map, Prime– Implicant Method–Binary Arithmetic: Binary Addition – Subtraction – Various Representations of Binary Numbers– Arithmetic Building Blocks–Adder–Sub tractor.							
III	Combinational Logic: Multiplexers – De multiplexers – Decoders – Encoders – Code Converters–Parity Generators and Checkers.							
IV	Sequential Logic: RS, JK,D, and TF lip -Flops– Master-Slave Flip- Flops. Registers: Shift Registers–Types of Shift Registers.							
V	Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up-Down Counters– Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs –Types of RAMs.							
Course Outcomes								
Course Outcomes	On completion of this course, students will;							
CO1	Identify the logic gates and their functionality							
CO2	Perform number conversions from one system to another system							
CO3	Understand the functions of combinational circuits							
CO4	Perform number conversions							
CO5	Perform Counter design and learn its operations.							

Text Books (Latest Editions)	
1. D.P. Leach and A.P. Malvino, <i>Digital Principles and Applications</i> – TMH – Fifth Edition – 2002. 2. M. Morris Mano, <i>Digital Logic and Computer Design</i> , PHI, 2001.	
Reference Book	
1. V. Rajaraman and T. Radhakrishnan, <i>Digital Computer Design</i> , Prentice Hall of India, 2001. 2. T.C. Bartee, <i>Digital Computer Fundamentals</i> , 6 th Edition, Tata McGraw Hill, 1991.	
Web Resources	
	Web resources from NDL Library, E-content from open source libraries

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO1	S	S	S	S	S	S	M	S	S
CO2	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S

S – Strong, M – Medium , L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3	3	3	3	3