SOURASHTRA COLLEGE, MADURAI – 625004

(An Autonomous Institution Re-accredited with 'A' grade by NAAC)

B.Sc. COMPUTER SCIENCE
(ARTIFICIAL INTELLIGENCE) – SYLLABUS

Under CBCS based on OBE)

(For the students admitted from the academic year 2025 – 2026 onwards)

ABOUT THE DEPARTMENT

The Department of Computer Science was established during the year 1987–88 with B.Sc. Computer Science Programme. Since then, the Department has been functioning successfully producing young Computer Science graduates every year, with well trained and experienced faculty members and supporting staff. So far, the Department has produced more than 1000 (33 batches) Computer Science graduates and they are all well placed in India & Abroad. The Department has been producing excellent results over a period of 35 years. The Department has adequate infrastructure with a well–equipped Computer Laboratory with LCD Projector, a well stacked Department Library, and well–furnished class rooms. From 2023 onwards we have got approval for Artificial Intelligence Programme.

VISION

- Apply a broad understanding of the fundamental theories, concepts, and applications of Computer Science in their career.
- Analyze a multifaceted computing problem and to apply principles of computing and other relevant disciplines to identify solutions and compare alternative solutions to computing problems.
- Apply Computer Science theory and software development fundamentals to produce computing–based solutions.
- To attain an ability to use current techniques, skills, and tools necessary for computing practice.
- To affiance in a wide range of careers and/or graduate studies in computer science or related fields with a zeal for lifelong learning.
- To communicate effectively, both orally and in writing and engaged in collaborative teamwork.
- Recognize the social and ethical errands of a professional working in the discipline**.**

MISSION

The Mission of the Department is to impart computer education to the students in the rural area of Madurai district, so that they become enlightened and intelligent, and to improve the standards of their life, as well as to produce graduates who excel in research and service. We also aim to inculcate the attitudes and values that will motivate them towards the continuous process of learning and leadership. We strive to educate ground–breaking skills and technology for the benefit of learners through incessant upgradation of curriculum.

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GRADUATE ATTRIBUTES

1. **(KB) A knowledge base for Computer Science**: Demonstrated competence in university level mathematics, natural sciences, Computer Science fundamentals, and specialized Computer Science knowledge appropriate to the program.
2. **(PA) Problem analysis**: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex Computer Science problems in order to reach substantiated conclusions
3. **(Inv.) Investigation**: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. **(Des.) Design:** An ability to design solutions for complex, open–ended Computer Science problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **(Tools) Use of Computer Science tools**: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern Computer Science tools to a range of Computer Science activities, from simple to complex, with an understanding of the associated limitations.
6. **(Team) Individual and teamwork**: An ability to work effectively as a member and leader in teams, preferably in a multi–disciplinary setting.
7. **(Comm.) Communication skills**: An ability to communicate complex Computer Science concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **(Prof.) Professionalism**: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **(Impacts) Impact of Computer Science on society and the environment**: An ability to analyze social and environmental aspects of Computer Science activities. Such ability includes an understanding of the interactions that Computer Science has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **(Ethics) Ethics and equity**: An ability to apply professional ethics, accountability, and equity.
11. **(Econ.) Economics and project management**: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of Computer Science and to understand their limitations.
12. **(LL) Life–long learning**: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The **B.Sc. Computer Science (Artificial Intelligence)** Graduates of the Sourashtra College will

PEO 1	attain a professional career by acquiring knowledge in scientific, mathematical, computing, and engineering principles.
PEO 2	apply, analyze, design, optimize, and implement skills to formulate and solve computer science, engineering, and multidisciplinary problems effectively.
PEO 3	utilize fundamental domain knowledge gained from core courses to develop innovative computing solutions, employing creativity and logical reasoning.
PEO 4	provide professional services using the latest technologies in the field of computer science.
PEO 5	cultivate leadership skills while adhering to ethical standards, promoting teamwork, and demonstrating effective communication and time management in the profession.
PEO 6	pursue higher studies, certifications, and research programs in alignment with market demands and emerging trends.

UNDERGRADUATE (UG) PROGRAMME OUTCOMES (POs)

Undergraduate (B.A., **B.Sc.,** B.Com., B.C.A., B.B.A., etc.,) is a 3 – year degree Programme with 6 semesters consisting the following Programme Outcomes (POs) under various criteria including critical thinking, problem solving, effective communication, societal/ citizenship/ ethical credibility, sustainable growth and employable abilities.

PO 1	**Critical Thinking**: Intellectual exploration of knowledge towards actions in clear and rational manner by understanding the logical connections between ideas and decisions.
PO 2	**Problem Solving**: Understanding the task/ problem followed by planning and narrow execution strategy that effectively provides the solution.
PO 3	**Effective Communication**: Knowledge dissemination by oral and verbal mechanisms to the various components of our society.
PO 4	**Societal/ Citizenship/ Ethical Credibility**: Realization of various value systems/ moral dimensions and demonstrate the empathetic social concern as well as equity in all the decisions, executions and actions.
PO 5	**Environmental Concern and Sustainable Growth**: Understanding the emerging environmental challenges and provide the possible contribution in sustainable development that integrates environment, economy and employment.
PO 6	**Skill Development and Employable Abilities**: Adequate training in relevant skill sector and creating employable abilities among the under graduates.

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PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of **B.Sc. Computer Science (Artificial Intelligence) Programme**, the students are expected / will be able to

PSO 1	apply basic microeconomic, macroeconomic and monetary concepts and theories in real life and decision making.
PSO 2	be aware of various economic issues related to Development, Growth, International Economics, Sustainable Development and Environment.
PSO 3	be familiar with the concepts and theories related to Finance, Investments and Modern Marketing.
PSO 4	evaluate various social and economic problems in the society and develop answer to the problems as global citizens.
PSO 5	enhance skills of analytical and critical thinking to analyze effectiveness of economic policies.
PSO 6	be ready and willing to embark on new ventures and initiatives, with a focus on critical thinking and a strong desire for continuous learning, particularly in the realm of life skills.

DISTRIBUTION OF CREDITS (UG PROGRAMME)

Part	Semester	Courses	No. of. Courses	Hrs.	Credits	Total Credit
I	I–IV	Language	4	6	3	12
II	I–IV	English	4	6	3	12
III	I–VI	Core	15	5–6	4–5	67
	I–VI	Elective and Elective/Allied	8	4–5	3–4	24
IV	I–II	SEC (Non Major Elective)	2	2	2	4
	I	Foundation Course FC	1	2	2	2
	III–IV	SEC (Discipline Specific/ Generic)	5	2	2	10
	IV	EVS (Environmental Studies)	1	2	2	2
	V	Value Education	1	2	2	2
	V	Internship	1	–	1	1
V	IV	Extension Activity	1	–	1	1
	V	Soft Skills (Self – Study)	1	–	1	2
	VI	General Knowledge (online) (Self – Study)	1	–	1	2
Additional credit will be given to any Online Course taken in SWAYAM Portal						
		Total				141

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B.Sc. COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)
COURSE STRUCTURE – I SEMESTER

S. No.	Course Code	Part	Course Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	25UACT11	I	**Tamil** – பொதுத் தமிழ்–I	6	3	25	75	100	3
	25UACH11		**Hindi** – General Hindi – I						
	25UACS11		**Sanskrit** – Poetry, Grammar and History of Sanskrit Literature						
2	25UACE11	II	**English –** General English – I	6	3	25	75	100	3
3	25UAIC11	III	**Core – 1:** Programming in C	5	3	25	75	100	5
4	25UAICP1		**Core – 2: Lab:** **C** Programming	5	3	40	60	100	5
5	25UAIA11		**Elective/Allied – 1:** Mathematical Foundation	4	3	25	75	100	3
6	25UAIN11	IV	**SEC – 1: NME:** Fundamentals of Information Technology	2	3	25	75	100	2
7	25UAIFC1		**Foundation Course –** Problem Solving Techniques	2	3	25	75	100	2
			TOTAL	**30**				**700**	**23**

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II – SEMESTER

S. No.	Course Code	Part	Course Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	25UACT21	I	**Tamil** – பொதுத் தமிழ்–II	6	3	25	75	100	3
	25UACH21		**Hindi** – General Hindi – II						
	25UACS21		**Sanskrit** – Prose, Grammar and History of Sanskrit Literature						
2	25UACE21	II	**English** – General English – II	6	3	25	75	100	3
3	25UAIC21	III	**Core – 3:** Object Oriented Programming with C++	5	3	25	75	100	5
4	25UAICP2		**Core – 4: Lab :** Object Oriented Programming with C++ Lab	5	3	40	60	100	5
5	25UAIA21		**Elective/Allied – 2:** Numerical Methods	4	3	25	75	100	3
6	25UAIN21	IV	**SEC – 2: NME:** Fundamentals of Computer	2	3	25	75	100	2
7	25UAISP1		**SEC – 3: DS: Lab:** Open Source Software Technologies	2	3	40	60	100	2
			TOTAL	**30**				**700**	**23**

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COURSE STRUCTURE – I SEMESTER

S. No.	Course Code	Part	Course Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	25UACT11	I	**Tamil** – பொதுத் தமிழ்–I	6	3	25	75	100	3
	25UACH11		**Hindi** – General Hindi – I						
	25UACS11		**Sanskrit** – Poetry, Grammar and History of Sanskrit Literature						
2	25UACE11	II	**English –** General English – I	6	3	25	75	100	3
3	25UAIC11	III	**Core – 1:** Programming in C	5	3	25	75	100	5
4	25UAICP1		**Core – 2: Lab: C** Programming	5	3	40	60	100	5
5	25UAIA11		**Elective/Allied – 1:** Mathematical Foundation	4	3	25	75	100	3
6	25UAIN11	IV	**SEC – 1: NME:** Fundamentals of Information Technology	2	3	25	75	100	2
7	25UAIFC1		**Foundation Course –** Problem Solving Techniques	2	3	25	75	100	2
			TOTAL	**30**				**700**	**23**

CA – Class Assessment (Internal)

SE – Summative Examination

SEC – Skill Enhancement Course

DS – Discipline Specific

NME – Non –Major Elective

T – Theory

P – Practical

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAIC11	PROGRAMMING IN C	CORE – 1	5	–	5

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓	
	National	✓	Local	✓	Regional	✓	Global			✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of a programming language and its features which enhances the user to write general purpose application programs.

COURSE OBJECTIVES:

- To familiarize the students with the understanding of code organization
- To improve the programming skills
- To make the students learn the basic programming constructs

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	outline the fundamental concepts of C programming languages, andits features	Upto K3
CO 2	demonstrate the programming methodology.	Upto K3
CO 3	identify suitable programming constructs for problem solving.	Upto K3
CO 4	select the appropriate data representation, control structures, functions and concepts based on the problem requirement.	Upto K3
CO 5	evaluate the program performance by fixing the errors.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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PROGRAMMING IN C

UNIT– I:

Studying Concepts of Programming Languages– Language Evaluation Criteria – Language design – Language Categories – Implementation Methods – Programming Environments – Overview of C: History of C– Importance of C– Basic Structure of C Programs–Executing a C Program– Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations

UNIT– II:

Decision Making and Branching: Decision Making and Looping – Arrays – Character Arrays and Strings

UNIT– III:

User Defined Functions: Elements of User Defined Functions– Definition of Functions– Return Values and their Types– Function Call– Function Declaration– Categories of Functions– Nesting of Functions–Recursion.

UNIT– IV:

Structures and Unions: Introduction– Defining a Structure– Declaring Structure Variables Accessing Structure Members– Structure Initialization– Arrays of Structures– Arrays within Structures– Unions– Size of Structures

UNIT– V:

Pointers: Understanding Pointers– Accessing the Address of a Variable– Declaring Pointer Variables– Initializing of Pointer Variables– Accessing a Variable through its Pointer– Chain of Pointers– Pointer Expressions– Pointer and Scale Factor– Pointer and Arrays– Pointers and Character Strings– Array of Pointers – Pointer as Function Arguments– Functions Returning Pointers– Pointers to Functions– File Management in C.

TEXT BOOKS:

1. Robert W. Sebesta, (2012), ***—Concepts of Programming Languages***, Fourth Edition, Addison Wesley (Unit I : Chapter – 1)
2. E. Balaguruswamy, (2010), ***—Programming in ANSI C***, Fifth Edition, Tata McGraw Hill Publications.

REFERENCE BOOKS:

1. Ashok Kamthane, (2009), ***—Programming with ANSI & Turbo C***, Pearson Education
2. Byron Gottfried, (2010), ***—Programming with C***, Schaums Outline Series, Tata McGraw Hill Publication

DIGITAL TOOLS:

http://www.tutorialspoint.com/cprogramming/
http://www.cprogramming.com /

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	2	2
CO2	3	3	2	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	2	3	2	2
CO5	3	3	2	3	2	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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OURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAICP1	LAB: C PROGRAMMING	CORE – 2 LAB	–	5	5

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	40	60	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship				✓	
	National	✓	Local	✓	Regional	✓	Global				✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values			

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of a programming language and its features which enhances the user to write general purpose application programs.

COURSE OBJECTIVES:

- The course aims to provide exposure to problem–solving through C programming
- It aims to train the student to the basic concepts of the C –Programming language
- Apply different concepts of C language to solve the problem

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	demonstrate the understanding of syntax and semantics of C programs.	Upto K3
CO 2	identify the problem and solve using C programming techniques.	Upto K3
CO 3	identify suitable programming constructs for problem solving.	Upto K3
CO 4	analyze various concepts of C language to solve the problem in an efficient way.	Upto K3
CO 5	develop a C program for a given problem and test for its correctness.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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LAB: C PROGRAMMING

1. Programs using Input/ Output functions
2. Programs on conditional structures
3. Command Line Arguments
4. Programs using Arrays
5. String Manipulations
6. Programs using Functions
7. Recursive Functions
8. Programs using Pointers
9. Files
10. Programs using Structures & Unions

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	2	2
CO2	3	3	2	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	2	3	2	2
CO5	3	3	2	3	3	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE CODE	COURSETITLE	CATEGORY	T	P	CREDITS
25UAIA11	MATHEMATICAL FOUNDATION	ELECTIVE/ ALLIED – 1	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓
	National	✓	Local	✓	Regional	✓	Global			✓
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values	

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of Discrete structures like Set theory, Relations, Functions, Matrices, Logic, Graph Theory

COURSE OBJECTIVES:

- To teach the basic concepts of set theory
- To impart knowledge on solving problems using logic
- To make the students understand the mathematical concepts of combinatory
- To make the students solve various problems in number theory
- To make the students study the basic concepts of relations and its applications

COURSEOUTCOMES (COs):

After the completion of the Course, the students will be able to

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	gain knowledge on set theory	Upto K3
CO 2	understand different mathematical logics and functions	Upto K3
CO 3	get an idea on permutations and combinations	Upto K3
CO 4	understand the different form of number theory	Upto K3
CO 5	understand relations and its applications	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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MATHEMATICAL FOUNDATION

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

UNIT – 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

UNIT – III: NUMBER THEORY

The Integers and Division, Integers and Algorithms, (Multiplication, Addition and Division – Sequences and Summations, Recursive algorithms, Program correctness

UNIT – IV: COMBINATORICS

The basics of counting, the pigeonhole principle, Permutations and Combinations, Binomial coefficients, Generalised permutations and combinations

UNIT – V: RELATIONS

Relations – Relations and their properties, Representing Relations, Closures of relations, Equivalence relations, Partial orderings – Recurrence Relations Binary Relations

TEXT BOOKS:

1. Rosen K.H ***.Discrete Mathematics and its Applications***, 5th edition, Tata Mc Graw Hills, 2003.
2. J.K. Sharma, ***Discrete Mathematics,*** 3rd Edition, Macmillan Reprint2011

REFERENCE BOOK:

Modern Algebra, S. Arumugam & A. Thangapandi Issac, Scitech publications, 2005

DIGITALTOOLS:

https://www.cou rsera.org/specializations/discrete–mathematics
https://www.javatpoint.com/discrete–mathematics–tutorial
https://medium.com/basecs/a–gentle–introduction–to–graph–theory–7969829ead8

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	1	1	3
CO2	2	2	1	1	1	1
CO3	1	1	2	3	1	1
CO4	1	3	1	1	1	3
CO5	1	1	2	2	2	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAIN11	FUNDAMENTALS OF INFORMATION TECHNOLOGY	SEC – 1 NME	2	–	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓	
	National	✓	Local	✓	Regional	✓	Global			✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		

COURSE DESCRIPTION:

The main objectives of this course to provide basic training of computer and its most common software use in office work. This course is most beneficial for beginners.

COURSE OBJECTIVES:

- To introduce Computer and its Components
- To make the students perform the Microsoft Word, Excel, PowerPoint and its operations

.COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	understand the basics of Computer and its Generations and the components of computer	Upto K3
CO 2	understand the introduction about MS Word and perform the Elements of window, Text Formatting, Text Manipulating options in MS Word	Upto K3
CO 3	understand the introduction about MS Excel and to insert and size the cells and implement formulas and worksheet.	Upto K3
CO 4	understand the introduction about MS Power Point and perform the slides manipulation and implement Multimedia and templates	Upto K3
CO 5	understand the introduction about Internet and Intranet	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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FUNDAMENTALS OF INFORMATION TECHNOLOGY

UNIT – I: INTRODUCTION TO COMPUTERS

Introduction, Definition, Characteristics of computer, Evolution of Computer, Block Diagram of a computer, Generations of Computer, Classification of Computers, Applications of Computer, Capabilities and limitations of computer.

UNIT – II: BASIC COMPUTER ORGANIZATION

Role of I/O devices in a computer system. Input Units: Keyboard, Terminals and its types. Pointing Devices, Scanners and its types, Voice Recognition Systems, Vision Input System, Touch Screen, Output Units: Monitors and its types. Printers: Impact Printers and its types. Non–Impact Printers and its types, Plotters, types of plotters, Sound cards, Speakers.

UNIT – III: STORAGE FUNDAMENTALS

Primary Vs Secondary Storage, Data storage & retrieval methods. Primary Storage: RAM ROM, PROM, EPROM, EEPROM. Secondary Storage: Magnetic Tapes, Magnetic Disks. Cartridge tape, hard disks, Floppy disks Optical Disks, Compact Disks, Zip Drive, Flash Drives

UNIT – IV: SOFTWARE

Software and its needs, Types of S/W. System Software: Operating System, Utility Programs Programming Language: Machine Language, Assembly Language, High Level Language their advantages & disadvantages. Application S/W and its types: Word Processing, Spread Sheets Presentation, Graphics, DBMS s/w

UNIT – V: OPERATING SYSTEM

Functions, Measuring System Performance, Assemblers, Compilers and Interpreters. Batch Processing, Multiprogramming, Multi–Tasking, Multiprocessing, Time Sharing, DOS, Windows, Unix/Linux

TEXT BOOKS:

1. G. Manjunath, ***Computer Basics***, Vasan Publications, 2010.
2. Pradeep K. Sinha & Priti Sinha, ***Computer Fundamentals***, 6th Edition, BPB Publications, 2004.
3. S. K Bansal, ***Fundamental of Information Technology***.

REFERENCE BOOKS:

1. Bhardwaj Sushil Puneet Kumar, ***Fundamentals of Information Technology,***
2. GG Wilkinson, ***Fundamentals of Information Technology,*** Wiley–Blackwell.
3. A Ravichandran, ***Fundamentals of Information Technology,*** Khanna Book Publishing.

DIGITAL TOOLS:

https://testbook.com/learn/computer–fundamentals
https://www.tutorialsmate.com/2020/04/computer–fundamentals–tutorial.html
https://www.javatpoint.com/computer–fundamentals–tutorial
https://www.tutorialspoint.com/computer_fundamentals/index.htm
https://www.nios.ac.in/media/documents/sec229new/Lesson1.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	3
CO2	3	2	2	3	3	2
CO3	2	3	3	3	3	3
CO4	3	3	2	3	3	3
CO5	3	3	3	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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(An Autonomous Institution Re-accredited with 'A' grade by NAAC)

B.Sc. COMPUTER SCIENCE

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Under CBCS based on OBE)

(For the students admitted from the academic year 2025 – 2026 onwards)

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAIFC1	PROBLEM SOLVING TECHNIQUES	FOUNDATION COURSE	2	–	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship				✓
	National	✓	Local	✓	Regional	✓	Global				✓
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		

COURSE DESCRIPTION:

This course will teach the students the skills necessary to solve problems effectively using the programming language.

COURSE OBJECTIVES:

- To familiarize with writing of algorithms, fundamentals of C and philosophy of problem solving
- To implement different programming constructs and decomposition of problems into functions

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	study the basic knowledge of Computers and analyze the programming languages	Upto K3
CO 2	learn the data types and arithmetic operations, know about the algorithms and develop program using flow chart and pseudocode	Upto K3
CO 3	determine the various operators, explain about the structures and illustrate the concept of Loops	Upto K3
CO 4	learn about Numeric data and character–based data, analyze about Arrays	Upto K3
CO 5	explain about DFD, illustrate program modules and create and read Files	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

Passed in the BoS Meeting held on 27/02/2025 **Signature of the Chairman**

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PROBLEM SOLVING TECHNIQUES

UNIT – I: INTRODUCTION

History, characteristics and limitations of Computer. Hardware/Anatomy of Computer: CPU, Memory, Secondary storage devices, Input Devices and Output devices. Types of Computers: PC, Workstation, Minicomputer, Main frame and Supercomputer. Software: System software and Application software. **Programming Languages:** Machine language, Assembly language, High–level language,4GL and 5GL–Features of good programming language. Translators: Interpreters and Compilers.

UNIT – II: DATA

Data types, Input, Processing of data, Arithmetic Operators, Hierarchy of operations and Output. Different phases in Program Development Cycle (PDC).Structured Programming: **Algorithm:** Features of good algorithm, Benefits and drawbacks of algorithm. Flowcharts: Advantages and limitations of flowcharts, when to use flowcharts, flowchart symbols and types of flowcharts. **Pseudo code:** Writing a pseudo code. Coding, documenting and testing a program: Comment lines and types of errors. Program design: Modular Programming.

UNIT – III: SELECTION STRUCTURES

Relational and Logical Operators –Selecting from Several Alternatives – Applications of Selection Structures.

Repetition Structures: Counter Controlled Loops –Nested Loops– Applications of Repetition Structures.

UNIT – IV: DATA

Numeric Data and Character Based Data. **Arrays:** One Dimensional Array – Two Dimensional Arrays – Strings as Arrays of Characters.

UNIT – V: DATA FLOW DIAGRAMS

Definition, DFD symbols and types of DFDs. Program Modules: Subprograms–Value and Reference parameters– Scope of a variable – Functions – Recursion. Files: File Basics– Creating and reading a sequential file– Modifying Sequential Files

TEXT BOOK:

Stewart Venit***, Introduction to Programming: Concepts and Design***, Fourth Edition, 2010, Dream Tech Publishers.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	3	2	3	3	3
CO5	3	3	3	3	3	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE STRUCTURE – II SEMESTER

S. No.	Course Code	Part	Course Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	25UACT21	I	**Tamil** – பொதுத் தமிழ்–II	6	3	25	75	100	3
	25UACH21		**Hindi** – General Hindi – II						
	25UACS21		**Sanskrit** – Prose, Grammar and History of Sanskrit Literature						
2	25UACE21	II	**English** – General English – II	6	3	25	75	100	3
3	25UAIC21	III	**Core – 3:** Object Oriented Programming with C++	5	3	25	75	100	5
4	25UAICP2		**Core – 4: Lab :** Object Oriented Programming with C++ Lab	5	3	40	60	100	5
5	25UAIA21		**Elective/Allied – 2:** Numerical Methods	4	3	25	75	100	3
6	25UAIN21	IV	**SEC – 2: NME:** Fundamentals of Computer	2	3	25	75	100	2
7	25UAISP1		**SEC – 3: DS: Lab:** Open Source Software Technologies	2	3	40	60	100	2
			TOTAL	**30**				**700**	**23**

CA – Class Assessment (Internal)
SE – Summative Examination
SEC – Skill Enhancement Course
DS – Discipline Specific
NME – Non –Major Elective
T – Theory
P – Practical

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAIC21	OBJECT ORIENTED PROGRAMMING WITH C++	CORE – 3	5	–	5

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓	
	National	✓	Local	✓	Regional	✓	Global			✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		

COURSE DESCRIPTION:

This course aims to impart fundamental knowledge to organize and structure data to the design and implementation of efficient algorithms and program development.

COURSE OBJECTIVES:

- To make the students understand Principles of Object Oriented Programming
- To make the students understand Token Expressions, Control Structures, Functions in C++, Classes & Objects, Constructors & Destructors, Operator Overloading, Inheritance, Virtual Functions &Polymorphism

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	explain OOP concepts such as encapsulation, inheritance, polymorphism, and abstraction, and understand their implementation in C++.	Upto K3
CO 2	understanding Token Expressions & Control Structures	Upto K3
CO 3	applying Functions in C++, Classes & Objects.	Upto K3
CO 4	analyzing Constructors & Destructors, Operator Overloading, Inheritance	Upto K3
CO 5	knowing the applications of Pointers, Virtual Functions &Polymorphism, Working with Files, Exception handling	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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OBJECT ORIENTED PROGRAMMING WITH C++

UNIT – I:

Principles of Objective Oriented Programming Object Oriented Programming Paradigm, Basic Concepts of Object–Oriented Programming, Benefits of Object–Oriented Programming, Object Oriented Languages, Applications of Object–Oriented Programming, Beginning with C++.

UNIT – II:

Token Expressions & Control Structures Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Conversions, Operator Overloading, Operator Precedence, Control Structures.

UNIT – III:

Functions in C++, Classes & Objects.The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend and Virtual Functions. Specifying a class, Member Functions, Arrays within a class, Static Member Functions, Arrays of Objects, Friendly Functions

UNIT – IV:

Constructors & Destructors, Operator Overloading, Inheritance Constructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, Defining Operator Overloading, Overloading Operators, Rules for Overloading Operators, Type Conversions

UNIT – V:

Pointers, Virtual Functions & Polymorphism, Working with Files, Exception handling Pointers, Pointers to Objects, this pointer, Pointer to Derived Classes, Virtual Functions, Classes for File Stream Operations, Opening and Closing a File, File Modes, File Pointers, Input Output Operations, Updating a File.

TEXT BOOK:

Object–oriented programming with C++ by E.Balagurusamy, 2nd Edition, TMH.

REFERENCE BOOKS:

1. Sourav Sahay, (2017), ***Object Oriented Programming with C++,*** 2ndEdition, Oxford University Press.
2. Reema Thareja, (2015), ***Object Oriented Programming with C++,*** 1st Edition, Oxford University Press.

DIGITAL TOOLS:

https://www.w3schools.com/cpp/cpp_oop.asp

https://www.geeksforgeeks.org/object–oriented–programming–in–cpp/

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	1	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAICP2	LAB: OBJECT ORIENTED PROGRAMMING WITH C++	CORE – 4	–	5	5

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓	
	National	✓	Local	✓	Regional	✓	Global			✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		✓

COURSE DESCRIPTION:

This course aims to impart fundamental knowledge to organize and structure data to the design and implementation of efficient algorithms and program development

COURSE OBJECTIVES:

To predict the performance of different algorithms in order to guide design decisions, provide theoretical estimation for the required resources of an algorithm to solve a specific computational problem.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	understand basics of Object–Oriented Programming	Upto K3
CO 2	understand Token Expressions & Control Structures	Upto K3
CO 3	apply Functions in C++, Classes & Objects	Upto K3
CO 4	analyze Constructors & Destructors, Operator Overloading, Inheritance	Upto K3
CO 5	know the applications of Pointers	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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LAB: OBJECT ORIENTED PROGRAMMING WITH C++
LIST OF PROGRAMS

1. Write a Program to find Simple Interest and Compound Interest.
2. Write a Program to demonstrate the working of following Loops: While, Do While, For, If–Else, switch
3. Write a Program to find greatest of three numbers.
4. Write a Program to add and subtract two matrices.
5. Write a Program to display elements of an array.
6. Write a Program to calculate Sum and Average of an array.
7. Write a Program to sort elements of an array using Bubble sort.
8. Write a Program to calculate Factorial of a number.
9. Write a Program to generate Fibonacci series.
10. Write a Program to show function Overloading.
11. Write a Program to create a class and access member function of a class
12. Write a program to show Constructor and Destructor in a class
13. Write a program to convert the temperature in Fahrenheit to Celsius and vice–a–verse

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	2	2	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	1	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAIA21	NUMERICAL METHODS	ELECTIVE/ ALLIED – 2	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship				✓	
	National	✓	Local	✓	Regional	✓	Global				✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values			

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge about Numerical methods.

COURSE OBJECTIVES:

- To introduce the various topics in Numerical methods.
- To make the students understand the fundamentals of algebraic equations.
- To apply interpolation and approximation on examples.
- To solve problems using numerical differentiation and integration.
- To solve linear systems, numerical solution of ordinary differential equations.

COURSE OUTCOMES (COs):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO 1	know how to solve various problems on numerical methods	Upto K3
CO 2	use approximation to solve problems	Upto K3
CO 3	differentiate and integration concept are applied	Upto K3
CO 4	apply, direct methods for solving linear systems	Upto K3
CO 5	understand Numerical solution of ordinary differential equations	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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NUMERICAL METHODS

UNIT – 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.

UNIT – II: ITERATIVE, INTERPOLATION AND 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

UNIT – III: INTERPOLATION WITH EQUAL INTERVAL

Difference operators and relations –Interpolation with equal intervals – Newton's forward and backward difference formulae.

UNIT – IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule

UNIT – V: INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

Single step methods – Taylor's series method – Euler's method – Modified Euler's method – RungeKutta method for solving (First, Second, Third & 4th) order equations – Multi step methods

TEXT BOOK:

S. Arumugam, A. Thangapandi Issac, A.Somasundaram, ***Numerical Methods***, Second Edition, SCITECH publications, 2009.

REFERENCE BOOKS:

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.

DIGITAL TOOLS:

1. https://vemu.org/uploads/lecture_notes/01_03_2023_1339762279.pdf
2. https://www.math.hkust.edu.hk/~machas/numerical–methods.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	1	1	3
CO2	2	2	1	1	1	1
CO3	1	1	2	3	1	1
CO4	1	3	1	1	1	3
CO5	1	1	2	2	2	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAIN21	FUNDAMENTALS OF COMPUTER	SEC – 2 NME	2	–	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓	
	National	✓	Local	✓	Regional	✓	Global			✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		

COURSE DESCRIPTION:

The focus of the subject is on introducing skills relating to IT basics, computer applications, programming, interactive medias, operating system basics etc.

COURSE OBJECTIVES:

- To make the students understand basic concepts and terminology of information technology
- To make the students understand about personal computers and their operation able to identify data storage and its usage

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	learn the basics of computer, construct the structure of the required things in computer, learn how to use it.	Upto K3
CO 2	develop organizational structure using for the devices present currently under input or output unit.	Upto K3
CO 3	understand concept of storing data in computer	Upto K3
CO 4	work with different software, write program in the software and applications of software.	Upto K3
CO 5	use Operating system in information technology which really acts as a interpreter between software and hardware.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

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FUNDAMENTALS OF COMPUTER

UNIT – I: INTRODUCTION TO COMPUTERS

Generations of Computer – Data and Information – Components of Computer – Software – Hardware – Input Devices – Output Devices — Types of Operating System.

UNIT – II: MS WORD

Introduction – Elements of Window – Files, Folders and Directories – Text Manipulating: Cut, Copy, Paste, Drag and Drop – Text Formatting: Font – Style, Size, Face and Colors (Both foreground and background) – Alignment – Bullets and Numbering – Header and footer– watermark – inserting objects (images, other application document) – Table creation – Mail merge.

UNIT – III: MS EXCEL

Introduction – Inserting rows and columns – Sizing rows and columns – Implementing formulas – Generating series – Functions in excel – Creation of Chart – Inserting objects – Filter – Sorting – Inserting worksheet.

UNIT – IV: MS POWERPOINT

Introduction – Slides Manipulation (Inserting new, Copy, paste, delete and duplicate slides) – Slide show– Types of Views – Types of Animations – Inserting Objects – Implementing multimedia (Video and Audio) – Templates (Built–in and User–Defined).

UNIT – V: INTERNET

Introduction to Internet and Intranet – Services of Internet – Domain Name – URL – Browser – Types of Browsers – Search Engine – E–Mail – Basic Components of E–Mail –How to send group mail. E–Commerce: Digital Signature – Digital Currency – Online shopping and transaction.

TEXT BOOKS:

1. G. Manjunath, ***Computer Basics***, Vasan Publications, 2010.
2. Pradeep K. Sinha & Priti Sinha, ***Computer Fundamentals***, 6th Edition, BPB Publications, 2004.

REFERENCE BOOKS:

1. Bhardwaj Sushil Puneet Kumar, ***Fundamental of Information Technology***
2. GG Wilkinson, ***Fundamentals of Information Technology,*** Wiley–Blackwell
3. A Ravichandran , ***Fundamentals of Information Technology,*** Khanna Book Publishing

DIGITAL TOOLS:

https://www.tutorialspoint.com/computer_fundamentals/index.htm
https://www.tutorialspoint.com/basics_of_computers/index.htm
https://www.tutorialspoint.com/word/index.htm
https://www.tutorialspoint.com/excel/index.htm

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	2	3
CO5	3	3	2	3	3	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
25UAISP1	LAB: OPEN SOURCE SOFTWARE TECHNOLOGIES	SEC – 3 LAB	2	–	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

Curriculum Design and Development	Employability		✓	Skill Oriented		✓	Entrepreneurship			✓	
	National	✓	Local	✓	Regional	✓	Global			✓	
Curriculum Enrichment	Professional Ethics		Gender		Environment and Sustainability		Human Values		Other Values		

COURSE DESCRIPTION:

This course will examine fundamental software testing and program analysis techniques.

COURSE OBJECTIVES:

- To study various Software techniques
- To study fundamental concepts in software testing

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	understand and describe the basic concepts of functional (black box) software testing	Upto K3
CO 2	understand the basic application of techniques used to identify useful ideas for tests.	Upto K3
CO 3	help determine the mission and communicate the status of testing	Upto K3
CO 4	characterize a good bug report, peer–review the reports	Upto K3
CO 5	understand where key testing concepts apply within the context of unified processes	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLYING

Passed in the BoS Meeting held on 27/02/2025 **Signature of the Chairman**

LAB: OPEN SOURCE SOFTWARE TECHNOLOGIES

SECTION – A

1. Write a Linux script to find the number of users who have logged in.
2. Write a Linux script to see the current date, user name and current directory.
4. Write a Linux script to print the numbers 5, 4, 3, 2, 1 using While loop.
5. Write a Linux script to set the attributes of a file.
6. Write a Linux script to convert lowercase to uppercase using trutility.
7. Write a Linux script to copy and rename a file.
8. Write a Linux script to add 5 numbers and find the average.
9. Write a Linux script to convert a decimal number to hexadecimal conversion.
10. Write a Linux script to find the factorial of a number.
11. Write a Linux script to check for palindrome**.**

SECTION – B

12. Write a Linux script to display Hello World in Bold, Blink effect and in different colors like red, green etc.
13. Write a Linux script to display a multiplication table.
14. Write a Linux script to perform arithmetic operations using case.
15. Write a Linux script to add two real numbers.
16. Write a Linux script to display the following pattern:

    1
    22
    333
    4444
    55555
17. Write a Linux script to find the sum of digits and reversing of a given number.
14. Write a Linux script to display the student mark details.
15. Write a Linux script to prepare electricity bill.
16. Write a Linux script to sort the numbers in ascending order.
17. Write a Linux script
    (i) To create and append a file
    (ii) To compare two files.

TEXT BOOK:

James Lee and Brent Ware, ***Open Source Web Development with LAMP using LINUX, Apache, MySQL, Perl and PHP***, Dorling Kindersley (India) Pvt. Ltd, 2008.

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1. Eric Rosebrock, Eric Filson, ***Setting up LAMP: Getting Linux, Apache, MySQL and PHP and Working Together***, John Wiley and Sons, 2004.
2. Anthony Butcher, ***Teach Yourself MySQL in 21 days***, 2nd Edition, Sams Publication.
3. Rich Bower, Daniel Lopez Ridreejo, Alian Liska, ***Apache Administrator's Handbook,*** Sams Publication.
4. Tammy Fox, ***RedHat Enterprise Linux 5 Administration Unleashed***, Sams Publication.
5. Naramore Eligabette, Gerner Jason, Wrox Press, Wiley Dreamtech Press, ***Beginning PHP5, Apache, MySQL Web Development***, 2005.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	2
CO2	2	3	3	2	3	2
CO3	3	3	3	3	3	3
CO4	3	2	2	3	3	3
CO5	3	3	3	3	3	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level