Course Handout

Institute/School Name	Chitkara University Institute of Engineering & Technology		
Department Name	Department of Computer Science & Engineering		
Programme Name	Bachelor of Engineering- Computer Science & Engineering (Artificial Intelligence)		
Course Name	Accelerated Computing with C/C++	**Session**	2024-2025
Course Code	24CAI1104	**Semester/Batch**	2nd/2024
L-T-P (Per Week)	2-0-4	**Course Credits**	4
Pre-requisite	Knowledge of basic programming concepts	**NHEQF Level**	4.5
Course Coordinator	Dr. Taniya Hasija	**SDG Number**	4, 9

1. Objectives of the Course

This course is directed towards developing young programmers through providing them the knowledge about computing resources, nespecially memory and processing cores before coding for a real-life problem. It will acquaint the learners with all necessary computing knowledge to develop an optimized code for a given problem. The course will also help programmers to create the most efficient parallel code which can be executed exploiting all existing processing cores in our machine. The main objectives of the courses are:

- To identify the differences between traditional and modern computing architectures.
- To study the art of programming different machines using C/C++.
- Assess the suitability of different programming paradigms for a range of problem types to facilitate effective language selection and program design.
- Design and implement programs in languages encompassing different programming paradigms to demonstrate effective and efficient computational problem solving.
- To acquire the ability to understand design and implement optimized parallel algorithms.

2. Course Learning Outcomes (CLOs)

Student should be able to:

	CLOs	Program Outcomes (PO)	NHEQF Level Descriptor	No. of Lectures
CLO1	Understand the sufficient machine architecture knowledge to build programs to solve mathematical problems using structured as well as object-oriented approach.	PO1, PO2, PO3, PO4, PO11, PS01	Q1, Q2	8
CLO2	Build logic to solve complex problems involving large arrays.	PO1, PO2, PO4, PO8, PO11, PS02, PS03	Q3, Q6	9
CLO3	Master the use of pointers to perform memory operations.	PO1, PO4, PO5, PO6, PO10, PO12, PS01	Q2, Q3	11
CLO4	Learn the art of performing data manipulation operations using object-oriented streams.	PO3, PO4, PO5, PO9, P11, P12, PS01	Q1, Q2	10
CLO5	Master the art of multithreading to create efficient use of hyper threading processors to solve data-centric problems.	PO2, PO3, PO4, PO5, PO7, PO12, PS02, PS03	Q6	8
Total Contact Hours				60

CLO-PO-PSO Mapping

Course Learning Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	**Type of Assessment's**
CLO1	L	L	L	L							M		L			Formative /Summative
CLO2	H	M		H				M			L			M	L	Formative /Summative
CLO3	H			H	M	M				M		L	H			Formative /Summative
CLO4			H	H	M				M		L	M	H			Formative /Summative
CLO5		M	H	H	M		M					M		H	M	Formative /Summative

H=High, M=Medium, L=Low

3. Recommended Books:

B01: Object Oriented Programming with C++' by Balagurusamy, E. , Eighth Edition, 2020.
B02: The Complete Reference C++' by Herbert Schildt , Tata McGraw Hill.
B03: Computer Architecture: A Quantitative Approach by David A. Patterson, Elsevier, 2011.
B04: C++ Concurrency in Action-Practical Multithreading by Anthony Williams, Manning.
B05: Test your C Skills by Yashwant Kanetkar, BPB Publications.
B06: Object Oriented Programming With C++ by Reema Thareja, Oxford University Press

4. Other readings and relevant websites:

Serial No.	Link of Journals, Magazines, websites and Research Papers
1.	https://ocw.mit.edu/courses/6-096-introduction-to-c-january-iap-2011/pages/lecture-notes/
2.	http://www.cplusplus.com/doc/tutorial/
3.	http://www.tenouk.com/cncplusplustutorials.html
4.	https://www.educative.io/blog/modern-multithreading-and-concurrency-in-cpp
5.	https://www.bogotobogo.com/cplusplus/multithreaded.php

5. Recommended Tools and Platforms

Dev-C++, Microsoft Visual Studio

6. Course Plan: Theory+ Lab

Theory Plan

Lect. No.	Topics
1-4	Understanding Memory Model: Understanding a basic Von Neumann Machine Architecture, Interpreter vs compiler, Flynn's Classification of Computers.
5-7	Understanding Computer Instruction Format: Understanding a Computer Instruction and Instruction Cycle.
8-14	Structured Programming: Understanding variables, Data types and operators, Conditional and Loop Constructs, Functions, Arrays and strings.
15-18	Pointers: Understanding pointers, Declaring & initializing pointers, Accessing Memory using Pointers, Pointers to Objects and functions.
19-20	Object-Oriented Programming: Understanding object-oriented paradigm, Comparison between procedural programming paradigm and object-oriented programming paradigm.
21-24	Classes and Objects: Specifying a class, Creating class objects.

Sessional Test-1 (1-24 Lectures)	
25-28	Classes and Objects: Static members, Static objects, Constant member function, Constant objects, Friend functions, Friend class.
29-42	Object-oriented features: Constructors and Destructors, function & Operator Overloading, Type Conversion, Inheritance, Virtual base class, Virtual Functions & Polymorphism.
43-50	Streams in C++: Files and Streams, how do Streams work, I/O stream Classes, Error Handling with IO Streams, Lower-level streams and memory buffers.
Sessional Test-2 (25-50 Lectures)	
51-60	Introduction to Concurrent Systems and Multithreading, Basic elements of a Multithreaded program, Introducing pthread.h and thread, Understanding the life cycle of a thread, writing parallel algorithms for parallel vector addition and matrix multiplication using multi-threading, Understanding Shared Memory Model and its Challenges during race condition.
END-TERM EXAM (FULL SYLLABUS)	

Lab Plan

Lab No.	Experiment
1	Write a program that converts temperatures between Celsius, Fahrenheit, and Kelvin using a menu-driven approach.
2	Write a program that accept marks for 5 subjects and calculate the grade based on the percentage using if-else or switch-case constructs.
3	Write a program to find all Armstrong numbers between two given numbers.
4	Write a function to reverse a number and check if it is a palindrome.
5	Write a program to find the second largest element in the given array.
5-6	Write a program to perform addition, subtraction, and multiplication of two matrices.
7-8	Create a program to swap two variables using call by reference and call by value.
9	Write a program to sort characters (numbers and punctuation symbols are not included) in a string.
10	Write a program to find the length of the longest word in a given string.
11-12	Define a class Student with attributes such as rollNumber, name, and marks (array of 5 subjects). Add methods to calculate the total marks, percentage, and grade of the student. Display the details of each student.
13-14	Create a class Employee with attributes id, name, designation, and salary. Add methods to: • Set employee details. • Calculate yearly salary. • Display employee details.
15	Create a class Complex that initializes the real and imaginary parts using a default and parameterized constructor. Write a destructor to display "Complex object destroyed."
16	Write a program to overload the function volume() to calculate the volume of a cube, a rectangular box, and a cylinder.

17	Write a program to demonstrate how the static members are shared across all objects.
18	Write a program to Overload the + operator in a class Vector to add two vectors represented by their x, y, and z components.
19-20	**Design a Bank Management System** to demonstrate OOP concepts, including classes, inheritance, and polymorphism. Create a base class Account with attributes like account number, holder name, and balance, and derive SavingsAccount and CurrentAccount classes. Use constructors, destructors, static members to track total accounts, function overloading for deposit/withdrawal, operator overloading for balance operations, and a friend function for fund transfers. Include polymorphism to calculate interest dynamically for different account types.
21-22	Create a program that accepts user input for a list of students (name and marks) and saves the details to a file students.txt. Then, read the file and display the details.
23-24	Create a program to merge two text files into a single file. Handle errors if any file is missing or inaccessible.
25	Write a program to create and run two threads that print messages ("Hello from Thread 1" and "Hello from Thread 2") simultaneously.
26	Write a program to calculate the sum of a large array using multiple threads. Divide the array into equal parts, and each thread calculates the sum of its portion.
Lab Evaluation (1-26 Lab No.)	

7. Delivery/Instructional Resources Theory

Plan (Theory +Lab):

Lect. No.	Topics	CLO	Book No, CH No, Page No	TLM	ALM	Web References	Audio-Video
1-4	• Understanding Memory Model • Understanding a basic Von Neumann Machine Architecture • Interpreter vs. compiler • Flynn's Classification of Computers	CLO01	B03, CH No. 2	Lecture	Think/pair/share	https://en.wikipedia.org/wiki/Von_Neumann_architecture	https://www.youtube.com/watch?v=efXI8anQwXo&list=PLEAYkSg4uSQ2qzihjdDEseWrrY1DyxH9P
5-7	• Understanding Computer Instruction Format • Understanding a computer Instruction and Instruction Cycle	CLO01	B03, Ch No. 3	Lecture	Quiz/ Test Questions	https://www.tutorialspoint.com/what-is-an-instruction-set-in-a-computer#:~:text=An%20instruction%20is%20a%20set,and%20bytes%20within%20the%20processor.&text=ADD%20%E2%88%92%20Add%20two%20nu	https://www.youtube.com/watch?v=efXI8anQwXo&list=PLEAYkSg4uSQ2qzihjdDEseWrrY1DyxH9P

						mbers%20together	
8-14	• Structured Programming • Understanding variables • Data types and operators • Conditional and loop Constructs • Functions • Array and Strings	CLO01	B02, Ch no. 1	Lecture	Leading Questions		https://www.youtube.com/watch?v=efXI8anQwXo&list=PLEAYkSg4uSQ2qzihjdDEseWrrY1DyxH9P
15-18	• Pointers • Understanding pointers • Declaring & initializing pointers • Accessing Memory using Pointers • Pointers to Objects and functions	CLO02	B02, Ch no. 5	Lecture	Quiz, Peer Reviews		https://www.youtube.com/watch?v=efXI8anQwXo&list=PLEAYkSg4uSQ2qzihjdDEseWrrY1DyxH9P
19-20	• Object-Oriented Programming • Understanding object-oriented paradigm • Comparison between procedural programming paradigm and object-oriented programming paradigm	CLO02	B01, Ch no. 1 and 2	Lecture	Test questions/ Quiz	http://www.cprogramming.com/tutorial/c++-tutorial.html	https://www.mililink.com/upload/article/1767042617aams_vol188_june_2019_a17_p775-787_hari_singh,_dinesh_chander_and_ravindara_bhatt.pdf
21-24	• Classes and Objects • Introduction to classes and Objects • Specifying a class • Creating class objects	CLO03	B01, Ch no. 5	Lecture	Brain Storming Session	https://www.youtube.com/watch?v=dkxaeZFswPM	https://www.youtube.com/watch?v=i_5pvt7ag7E
25-28	• Classes and Objects • Static members, Static objects • Constant member function • Constant objects • Friend functions • Friend class	CLO03	B01, Ch no. 5	Lecture	Test Questions	https://www.youtube.com/watch?v=dkxaeZFswPM	https://www.youtube.com/watch?v=i_5pvt7ag7E
29-42	• Object-oriented features • Constructors and Destructors	CLO03	B01, Ch no. 7, 8 and 9	Lecture	Brain Storming Session	http://www.cplusplus.com/doc/tutorial/	https://www.cse.iitb.ac.in/~cs101/2019.1/lectures/Lecture2

	• Function & Operator Overloading • Type Conversion • Inheritance • Virtual base class • Virtual Functions • Polymorphism						0.pdf
43-50	• Streams in C++ • Files and Streams • How do Streams work • I/O stream Classes • Error Handling with IO Streams • Lower-level streams and memory buffers	CLO06	B02, Ch no. 9	Lecture	Test Questions	https://www.tutorialspoint.com/cplusplus-stream-classes-structure	https://www.cs.uic.edu/~jbell/CourseNotes/CPlus/FileIO.html
51-60	• Concurrent Systems: Multi-threading in C++ • Introduction to Concurrent Systems and Multithreading • Basic elements of a Multithreaded program • Introducing Pthread.h and thread • Understanding the life cycle of a thread • Writing parallel algorithms for parallel vector addition and matrix multiplication using multi-threading • Understanding Shared Memory Model and its Challenges during race condition	CLO04	B04, Ch no. 1, 2, 3 and 4	Lecture	Leading Questions	https://www.educative.io/blog/modern-multithreading-and-concurrency-in-cpp https://www.geeksforgeeks.org/multiplication-of-matrix-using-threads/	https://www.cs.uic.edu/~jbell/CourseNotes/CPlus/FileIO.html

8. Remedial Classes

After every Sessional Test, different types of learners will be identified, and special discussions will be planned and scheduled accordingly.

Action Plan for different types of learners:

Learner Type-I	Learner Type- II	Learner Type- III
Remedial Classes, Doubt Sessions, Guided Tutorials	Workshop, Doubt Session	Projects, Coding Competitions

9. Self-Learning

Assignments to promote self-learning, survey of contents from multiple sources.

S. No.	Topics	CLO	ALM	References/MOOCS
1	Problem solving Hackathons	CLO002, CLO005	Think/pair/share	Hacker earth, HarkerRank, CodeWars
2	Concurrent Systems	CLO01, CLO04, CLO06	Think/pair/share	https://www.geeksforgeeks.org/cpp-concurrency/

10. Delivery Details of Content Beyond Syllabus

Content beyond syllabus covered (if any) should be delivered to all students that would be planned, and schedule notified accordingly.

S. No	Advanced Topics, Additional Reading, Research papers and any	CLO	POs	ALM	References/MOOCS
1	Multi-threading using C	CLO01, CLO02, CLO05, CLO06	PO1, PO2, PO3, PO4, PO7, PO11	Think/pair/share	http://www.csc.villanova.edu/~mdamian/threads/posixthreads.html
2	Real world applications of multithreading	CLO01, CLO03, CLO05, CLO06	PO1, PO2, PO3, PO5, PO7, PO11	Think/pair/share	https://www.nilebits.com/blog/2023/10/real-world-examples-of-multithreading-in-net-applications/

11. Evaluation Scheme & Components:

Assessment Type	Evaluation Component	Type of Component	No. of Assessments	% Weightage of Component	Max. Marks	Mode of Assessment	CLO
Formative	Component1	Continuous evaluation	01*	15%	15	Lab Evaluation	CLO01, CLO02, CLO03, CLO04, CLO05, CLO06
Summative	Component 2	Sessional Tests (STs)	02**	35%	35	Computer Based Test	CLO01, CLO02, CLO03, CLO04, CLO05, CLO06
Summative	Component3	End Term	01***	50%	50	Computer Based Test	CLO01, CLO02, CLO03, CLO04, CLO05, CLO06
	Total		**100%**				

** Lab Evaluation is mandatory for all the students.*

*** All STs are mandatory.*

**** To appear for the End Term Exam, attendance must be 75% or more.*

12. Syllabus of the Course:

Subject: Accelerated Computing with C++		**Course code:** 24CAI1104	
S. No.	**Topic (s)**	**No. of Lectures**	**Weightage %**
1.	**Understanding Memory Model:** Understanding a basic Von Neumann Machine Architecture, Interpreter vs compiler, Flynn's Classification of Computers. Understanding a Computer Instruction and Instruction Cycle.	07	7%
2.	Structured Programming: Understanding variables, Data types and operators, Conditional and Loop Constructs, Functions.	07	12%
3.	Pointers: Understanding pointers, Declaring & initializing pointers, Accessing Memory using Pointers, Pointers to Objects and functions.	4	10%
4.	Object-Oriented Programming: Understanding object-oriented paradigm, Comparison between procedural programming paradigm and object-oriented programming paradigm. Classes and Objects: Specifying a class, Creating class objects. Static members, Static objects, Constant member function, Constant objects, Friend functions, Friend class.	10	25%
5.	Object-oriented features: Constructors and Destructors, function & Operator Overloading, Type Conversion, Inheritance, Virtual base class, Virtual Functions & Polymorphism.	14	18%
6.	Streams in C++: Files and Streams, how do Streams work, I/O stream Classes, Error Handling with IO Streams, Lower-level streams and memory buffers.	8	16%
7.	Introduction to Concurrent Systems and Multithreading, Basic elements of a Multithreaded program, Introducing pthread.h and thread, Understanding the life cycle of a thread, writing parallel algorithms for parallel vector addition and matrix multiplication using multi-threading, Understanding Shared Memory Model and its Challenges during race condition.	10	12%

13. Academic Integrity Policy:

Education at Chitkara University builds on the principle that excellence requires freedom where Honesty and integrity are its prerequisites. Academic honesty in the advancement of knowledge requires that all students and Faculty respect the integrity of one another's work and recognize the importance of acknowledging and safeguarding intellectual property. Any breach of the same will be tantamount to severe academic penalties.

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinator	Dr. Taniya Hasija	
Head-Academic Delivery	Dr. Kamaldeep Garg	
Dean (CSE-AI)	Dr. Sushil Narang	
Date (DD/MM/YYYY)	09/01/2025	