INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

INFORMATION TECHNOLOGY

COURSE DESCRIPTOR

Course Title	**C++ STANDARD TEMPLATE LIBRARY**				
Course Code	ACSB06				
Programme	B. Tech				
Semester	III	CSE | IT			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	1.5
Chief Coordinator	Mrs. SwarajyaLaxmi, Assistant Professor				
Course Faculty	Mr. RM Noorullah, Assistant Professor Mr. N V Krishna Rao, Assistant Professor Mrs. B Ramyasree, Assistant Professor				

I. COURSE OVERVIEW:

This course covers some of the general-purpose data structures and algorithms, and software development. The Standard Template Library (STL) is a set of C++ template classes to provide common programming data structures and functions such as lists, stacks, arrays, etc. It is a library of container classes, algorithms, and iterators. It is a generalized library and so, its components are parameterized. A working knowledge of template classes is a prerequisite for working with STL.

STL has four components

- Algorithms
- Containers
- Functions
- Iterators

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	C++

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
C++ Standard Template Library	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	Laboratory		Total Marks
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	Performance	Calculations and Graph	Results and Error Analysis	Viva	Total
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Videos / Student Viva
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Lab Exercises / Student Viva
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Videos / Student Viva
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Lab Exercises
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage independent and life-long learning in the broadest context of technological change.	2	Videos

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer - based systems of varying complexity.	3	Videos
PSO2	**Software Engineering Practices:** The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success.	3	Lab Exercises
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.	1	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand how C++ STL improves C with predefined libraries.
II	Learn how to implement C++ standard Template Libraries.
III	Understand the concept of vectors, maps, stacks, queues and many more.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the concept of control structures, vectors, maps and implementation of stack and queue.	CLO 1	Understand the concepts of control structures to print different patterns.
		CLO 2	Explore the usage of vectors and maps to store and access the set of elements.
		CLO 3	Understand working and implementation of stack and queue.
CO 2	Understand the operations of sets, strings and pairs	CLO 4	Understand the implementation of sets and its operations
		CLO 5	Understand the operations of strings and pairs.
CO 3	Explore various operations on arrays, lists, multisets, multimaps, unordered sets and set operations	CLO 6	Understand the operations of strings and pairs.
		CLO 7	Understand the basic operations of multiset and multimap.
		CLO 8	Understand the concept of unordered sets
		CLO 9	Understand the operations like set, union and intersection
CO 4	Understand the implementation of queue using linked list and permutations.	CLO 10	Implement the queue using linked list
		CLO 11	Understand the concept of permutations.
CO 5	Understand the concept of lexicographical order	CLO 12	Understand the concept of lexicographical to arrange the strings in lexicographical order.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACSB06.01	CLO 1	Understand the concepts of control structures to print different patterns.	PO1	3
ACSB65.02	CLO 2	Explore the usage of vectors and maps to store and access the set of elements.	PO3	3
ACSB06.03	CLO 3	Understand working and implementation of stack and queue.	PO3, PO5	3
ACSB06.04	CLO 4	Understand the implementation of sets and its operations	PO1, PO5	3
ACSB06.05	CLO 5	Understand the operations of strings and pairs.	PO1, PO 5	3
ACSB06.06	CLO 6	Understand the operations of strings and pairs.	PO3, PO5	3
ACSB06.07	CLO 7	Understand the basic operations of multiset and multimap.	PO3, PO5	3
ACSB06.08	CLO 8	Understand the concept of unordered sets	PO3, PO5	3
ACSB06.09	CLO 9	Understand the operations like set, union and intersection	PO1, PO 5	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACSB06.10	CLO 10	Implement the queue using linked list	PO2,PO5	3
ACSB06.11	CLO 11	Understand the concept of permutations.	PO2,PO5	3
ACSB06.12	CLO 12	Understand the concept of lexicographical to arrange the strings in lexicographical order.	PO2, PO3	3

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO5	PSO1	PSO2	PSO3
CO 1	3		3	2	3		
CO 2	3			2			2
CO 3	3		3	2			2
CO 4		3		2			
CO 5		3	3	2			2

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2			3										3		
CLO 3			3		2								3		
CLO 4	3				2										
CLO 5	3				2										2
CLO 6	3				2								3		
CLO 7			3		2								3		
CLO 8			3		2								3		
CLO 9	3				2								3		
CLO 10		3			2								3		
CLO 11		3			2										

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 12		3	3		2										2

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	-	SEE Exams	PO 1, PO 2 PO 3, PO 5	Lab Exercises	PO 5	Seminars	PO 1, PO 2
Laboratory Practices	PO 1, PO 5	Student Viva	PO 1, PO 2 PO 3, PO 2	Mini Project	-	Certification	-

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

WEEK-1	CONTROL STRUCTURES

a. In this problem, you need to print the pattern of the following form containing the numbers from 1 to n.

4 4 4 4 4 4 4
4 3 3 3 3 3 4
4 3 2 2 2 3 4
4 3 2 1 2 3 4
4 3 2 2 2 3 4
4 3 3 3 3 3 4
4 4 4 4 4 4 4
Input: 2
Output:
2 2 2
2 1 2
2 2 2

b. Given a positive integer denoting n, do the following:
If 1<=n<=9, then print the lowercase English word corresponding to the number (e.g., one for 1, two for 2 , etc.). If n>9, print Greater than 9.
Input: 5
Output: five

WEEK-2	VECTORS AND MAPS

a. A left rotation operation on a vector of size N shifts each of the array's elements 1 unit to the left. For example, if 2 left rotations are performed on array [1,2,3,4,5], then the array would become[3,4,5,1,3 . Given an vector of n integers and a number, d , perform d left rotations on the array. Then print the updated array as a single line of space-separated integers. Print a single line of n space-separated integers denoting the final state of the array after performing d left rotations.
Sample Input
5 4

1 2 3 4 5
Output:
5 1 2 3 4

b. Prasad is working as teacher in one school. He evaluated exam papers for all students. He decided to store their marks in his computer using their names. Can you please suggest best data structure. For example
Marks[“Ramu”]=98
Marks[“Janu”]=87

WEEK-3	STACK AND QUEUE

a. You have an empty sequence, and you will be given queries. Each query is one of these three types:

1 x -Push the element x into the stack.
2 -Delete the element present at the top of the stack.
3 -Print the maximum element in the stack.
For each type 3 query, print the maximum element in the stack on a new line.
Sample Input
10
1 9
7 2
1 20
2
1 26
1 20
2
3
1 91
3
Sample Output
26
91

b. You must first implement a queue using two stacks. Then process queries, where each query is one of the 3 following types:
1 x: Enqueue element into the end of the queue.
2: Dequeue the element at the front of the queue.
3: Print the element at the front of the queue. For each query of type, print the value of the element at the front of the queue on a new line.
Sample Input
10
1 42
2
1 14
3
1 28
3
1 60

1 78
2
2
Sample Output
14
14

WEEK-4	SETS AND STRINGS

a. You will be given Q queries. Each query is of one of the following three types:
1. x : Add an element x to the set.
2. x : Delete an element x from the set. (If the number is not present in the set, then do nothing).
3. x : If the number x is present in the set, then print "Yes"(without quotes) else print "No"(without quotes).
For queries of type 3 print "Yes"(without quotes) if the number x is present in the set and if the number is not present, then print "No"(without quotes).Each query of type 3 should be printed in a new line.
Sample Input
8
1 9
1 6
1 10
1 4
3 6
3 14
2 6
3 6
Sample Output
Yes
No
No
b. You are given a string containing characters A and B only. Your task is to change it into a string such that there are no matching adjacent characters. To do this, you are allowed to delete zero or more characters in the string.
Your task is to find the minimum number of required deletions.
For example, given the string s=AABAAB, remove an A at positions 0 and 3 to make s=ABAB in 2 deletions.

WEEK-5	SORTINGS AND PAIRS

a. Raju and Ravi are friends. Raju asked Ravi to arrange the set of string in ascending order (Dictionary format). Please help the Ravi to put the strings in ascending order.
b. Teacher given a task to students find the unvisited elements in the given matrix. The students are struggling to find the unvisited elements in the list. Please help them to solve.

WEEK-6	ARRAYS AND LISTS

a. All friends are invited and they arrive at the party one by one in an arbitrary order. However, they have certain conditions — for each valid i, when the i-th friend arrives at the party and sees that at that point, strictly less than Ai other people (excluding Chef) have joined the party, this friend leaves the party; otherwise, this friend joins the party. Help Chef estimate how successful the party can be — find the maximum number of his friends who could join the party (for an optimal choice of the order of arrivals).
Input: 6
3 1 0 0 5 5
Output: 4

WEEK-7	MULTISET AND MULTIMAPS
a. Kattapa, as you all know was one of the greatest warriors of his time. The kingdom of Maahishmati had never lost a battle under him (as army-chief), and the reason for that was their really powerful army, also called as Mahasena. Kattapa was known to be a very superstitious person. He believed that a soldier is "lucky" if the soldier is holding an even number of weapons, and "unlucky" otherwise. He considered the army as "READY FOR BATTLE" if the count of "lucky" soldiers is strictly greater than the count of "unlucky" soldiers, and "NOT READY" otherwise. Given the number of weapons each soldier is holding, your task is to determine whether the army formed by all these soldiers is "READY FOR BATTLE" or "NOT READY". Input: 4 11 12 13 14 Output: NOT READY	
WEEK-8	**UNORDERED SETS**
a. You are given two lists of N distinct numbers. Sort both the list and print them alternatively starting with list one. Input: 7 5 4 3 6 2 1 7 15 14 13 16 12 11 17 Output: 1 11 2 12 3 13 4 14 5 15 6 16 7 17	
WEEK-9	**SET UNION AND INTERSECTION**
a. A class contains two subjects and students can take one or two subjects as there wish. Here, students opted subjects on there own interest. Now, your task is to print all the total students count and students names, and also print how many took two subjects and their names. Input: string first[] = { "John", "Bob", "Mary", "Serena" }; string second[] = { "Jim", "Mary", "John", "Bob" }; Output: Total students: 6 Names: Neha Rakesh Sachin Sandeep Serena Vaibhav Opted Two subjects: 3 Names: Bob John Mary	
WEEK-10	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
a. A class contains two subjects and students can take one or two subjects as there wish. Here, students opted subjects on their own interest. Now your task to find the student names who are attending first subject but not second and vice versa. Input: 4 "John", "Bob", "Mary", "Serena" 4 "Jim", "Mary", "John", "Bob" Output: Attending First subject but not second: Serena Attending Second subject but not first: Jim	
WEEK-11	**PERMUTATIONS**
IARE college has designed a new challenge called BuildIT Competitive Programming. In this game, each team contains N members and they are specialised in either Java Programming or Python Programming. The challenge contains n1 java questions and n2 Python questions. So, team members are decided to seat in all specialized members as one group. So that, number of ways the N members seat in the programming contest. For example: a team contains _ab‘ java programmers and _cde‘ python programmers (a, b) (c, d, e)	

(b,a) (c, e, d)
(d, c, e)
(d, e, c)
(e, c, d)
(e, d, c)
So, total ways are = 12
Sample Input:
ab cde
Sample Output:
abcde
abced
abdce
abdec
abecd
abedc
bacde
baced
badce
badec
baecd
baedc

WEEK-12	LEXICOGRAPHICAL

a. Ravi and Raju are best friends. Ravi given a set of strings to Raju and ask him to find smaller string as per lexicographical order. Please help him to find.
For example:
Input:
4
abacus
apple
car
abba
Output:
abacus

TEXT BOOKS:

1. Bjarne Stroustrup, "Programming: Principles and Practice Using C++" 2nd Edition, 2014.
2. Herbert Schildt, "C++: The Complete Reference", 4th Edition, 2017.

WEB REFERENCES:

1. https://www.sanfoundry.com/cpp programming-examples-stl/.
2. https://www.geeksforgeeks.org/the-c-standard-template-library-stl/.
3. https://www.tutorialspoint.com/cplusplus/cpp_stl_tutorial. html.
4. http://www.cplusplus.com/reference/stl/.

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Control Structures	CLO 1	T2:15.1
2	Vectors and Maps	CLO 2	T1:5.1
3	Stack and Queue	CLO 3	T1:5.2 T2 : 10.2
4	Sets and Strings	CLO 4	T1:7.1 T2:8.1
5	Sorting and Pairs	CLO 5	T2:26.8

Week No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
6	Arrays and Lists	CLO 6	T1:9.2
7	Multi set and Multi maps	CLO 7	T2:26.14
8	Unordered Sets	CLO 8	T1:7.2
9	Set Union And Intersection	CLO 9	T1:7.2 T2:21.61
10	Implementation of Queue Using Linked List	CLO 10	T2:25.12
11	Permutations	CLO 11	T2:25.16 T:21.29
12	Lexicographical	CLO 12	T1:8.1

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Familiarizing the AVL Trees in developing application level programs.	Laboratory Sessions	PO 1, PO 2	-
2	Solving different problems and Practicing various debugging strategies to become a good programmer	Extra Lab Sessions, Participating in Coding contests.	PO 2	PSO 3

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HOD, IT