COMPILER FOR HPC

III Semester: CSE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCSB23	**Elective**	3	0	0	3	30	70	100

Contact Classes: 45	Total Tutorials: Nil	Total Practical Classes: Nil	Total Classes: 45

I. COURSE OVERVIEW:
The course provides students to possess a strong foundation in high-performance computing, including proficiency in programming languages, optimization techniques, and an understanding of different architectures. This equips them with the skills needed to develop and optimize software for demanding computational tasks and harness the full potential of high-performance systems.

II. OBJECTIVES:
The students will try to learn:
 I.   The objective of this course is to introduce structure of compilers and high performance
 II. The Compiler design for students.
 III. The Concepts of cache coherence and parallel loops in compilers are included

III. COURSE OUTCOMES:
After successful completion of the course, students should be able to:

CO 1	**Outline** various languages used in high performance systems with an illustration.	Create
CO 2	**Demonstrate** Usage of data dependence in parallel loops and Scalar analysis Using FUD Chains.	Apply
CO 3	**Summarize a** different types of loop transformation techniques used in loop restructuring and optimizing.	Evaluate
CO 4	**Make use of** different types of Loops used in Concurrency and Vector Analysis in High Performance Computing Systems.	Apply
CO 5	**Identify** different types of message passing and scalable memory sharing machines used in compilers for High Performance Computing.	Remember

IV. SYLLABUS

UNIT-I	HIGH PERFORMANCE SYSTEMS	Classes: 09

High Performance Systems, Structure of a Compiler, Programming Language Features, languages for High Performance.

UNIT-II	DATA DEPENDENCE AND SCALAR ANALYSIS WITH FACTORED USE-DEF CHAINS	Classes: 09

Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.
Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, and Data Dependence for Scalars. Data Dependence Analysis for Arrays.

UNIT-III	LOOP RESTRUCTURING AND OPTIMIZING FOR LOCALITY	Classes: 09

Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls,Inter-procedural Analysis.

Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.

Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

UNIT-IV	CONCURRENCY ANALYSIS AND VECTOR ANALYSIS	Classes: 09

Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.

Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers

UNIT-V	MESSAGE-PASSING MACHINES AND SCALABLE SHARED-MEMORY MACHINES	Classes: 09

Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.

Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Text Books:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

Reference Books:

1. http://www.sctie.iitkgp.ernet.in/
2. http://www.rkala.in/softcomputingvideos.php
3. http://www.sharbani.org/home2/soft-computing-1
4. http://www.myreaders.info/html/soft_computing.html

E-Text Books:

1. https://www.books.google.co.in/books?id=bVbj9nhvHd4C

2. https://www.books.google.co.in/books?id=GrZHPgAACAAJ&dq=1.+J.S.R.Jang,+C.T.Sun+and+E. Mizutani,+Neuro,+Fuzzy+and+Soft+Computing,+PHI,+2004,Pearson+Education.