COURSE CONTENT

ADVANCED COMPUTER ARCHITECTURE								
II Semester: CSE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCSE14	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Computer Organization and Architecture								

1. COURSE OVERVIEW:

This course is designed to provide students with in-depth knowledge of the design principles, organization, and performance evaluation of modern computer systems. It covers the concepts related to modern processor architectures, including pipelining, superscalar processors, out-of-order execution, speculation, and advanced instruction-level parallelism. Equip students for roles in computer engineering, hardware design, system optimization, research, and development in the ever-evolving field of computer systems and architecture.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concepts and principles of parallel and advanced computer architectures.
II. The design techniques of Scalable and multithreaded architectures.
III. The concepts and techniques of parallel and advanced computer architectures to design modern computer systems.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to

CO1	Categorize Parallel computer models, and program flow mechanisms to implement parallelism.
CO2	Summarize the challenges of realizing different kinds of parallelism and leverage them for performance advancement
CO 3	Apply the concept of memory hierarchy for efficient memory design and virtual memory to overcome the memory wall
CO 4	Explore the working of pipelining, and instruction-level parallelism using static, dynamic, and advanced techniques of scheduling
CO 5	Classify multiprocessors, and thread-level parallelism using shared, distributed, and directory-based memory models.
CO 6	Outline the principles and characteristics of vector processors, vector pipelines, SIMD execution, and vector instructions.

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION (10)

Theory of Parallelism, Parallel computer models, The State of Computing, Multiprocessors and multicomputers, Multivector and SIMD Computers, PRAM and VLSI models, Architectural development tracks, Program and network properties, Conditions of parallelism, Program partitioning and Scheduling, Program flow Mechanisms, System interconnect Architectures.

MODULE-II: PRINCIPLES OF SCALABLE PERFORMANCE (09)

Principles of Scalable performance, Performance metrics and measures, Parallel Processing applications, Speed up performance laws, Scalability Analysis and Approaches, Hardware Technologies, Processes and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors.

MODULE-III: SHARED MEMORY ORGANIZATIONS (09)

Shared-memory organizations, Sequential and weak consistency models, Pipelining and superscalar techniques, Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, superscalar pipeline design.

MODULE-IV: PARALLEL AND SCALABLE ARCHITECTURES (09)

Parallel and Scalable Architectures, Multiprocessors and multicomputers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multicomputer, Message-passing Mechanisms, Multivector and SIMD computers.

MODULE-V: VECTOR PROCESSING PRINCIPLES (09)

Vector Processing Principles, Multivector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5.

V. TEXTBOOKS:

1. Kai Hwang “Advanced Computer Architecture” Third Edition, Tata McGraw-Hill, 2016,

VI. REFERENCE BOOKS:

1. Computer Architecture, J.L. Hennessy and D.A. Patterson, 4th Edition, ELSEVIER.
2. Advanced Computer Architectures, S.G.Shiva, Special Indian edition, CRC, Taylor & Francis.
3. Introduction to High-Performance Computing for Scientists and Engineers, G. Hager and G. Wellein, CRC Press, Taylor & Francis Group.
4. Advanced Computer Architecture, D. Sima, T. Fountain, P. Kacsuk, Pearson education.
5. Computer Architecture, B. Parhami, Oxford Univ.Press.

VII. WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs47/preview
2. https://www.academia.edu/7318769/Computer_Architecture_Recommended_Reference_Books
3. https://www.researchgate.net/publication/329076555_Advanced_Computer_Architectures

VIII. E-TEXTBOOKS:

1. https://onlinecourses.nptel.ac.in/noc21_cs47/preview
2. https://abit.edu.in/wp-content/uploads/2022/07/advanced-computer-architecture.pdf
3. https://www.academia.edu/7318769/Computer_Architecture_Recommended_Reference_Books

IX. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics

4. Open,Ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper, I
8. Model question paper, II
9. Lecture notes
10. Power Point presentation
11. E-Learning Readiness Videos (ELRV)