Semester-VI
Parallel Computing (IT-6005)

Course Code	IT-6005	Credits-4	L-3, T-1, P-0
Name of the Course	Parallel Computing		
Lectures to be Delivered	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min Pass Marks: 40	Maximum Time: 3 hrs
Continuous Assessment (based on sessional tests (2) 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For Candidates:** Candidates are required to attempt five question in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in section E. Use of non-programmable calculators is allowed.

Section A

Review of Computer Architecture: Taxonomy of MIMD Computers, Multi-vector and SIMD, Computers, Vector Supercomputers SIMD Supercomputers.

PRAM and VLSI Models: Parallel Random Access Machines, VLSI Complexity Model.

Architectural Development Tracks: Multiple-Processor Tracks, Multi-vector and SIMD Tracks, Multithreaded and Dataflow Tracks.

Conditions and Parallelism: Data and Resource Dependences, Hardware and Software Parallelism, The role of compilers.

Program partitioning and scheduling: grain Sizes and Latency, Grain Packing and scheduling, static Multiprocessor Scheduling.

Program Flow Mechanisms: control flow Mechanism, Demand-Driven Mechanism, Comparison of Flow Mechanisms, System Interconnect Architectures: Network properties and Routing, Static Connection networks, Dynamic Connection Networks.

Section B

Performance Metrics and Measures: Parallelism Profile in Programs, Harmonic mean Performance, Efficiency, Utilization and Quality, Standard Performance Measures.

Speedup performance Law: Amdahl's law for a fixed workload, Gustafron's Law for sealed problems.

Scalability Analysis and Approaches: Scalability metrics and Goals, Evolution of Scalable Computers.

Advance Processor Technology: Instruction set architecture, CISC and RISC Scalar processors.

Superscalar and Vector Processors: Superscalar Processors, The VLIW Architecture, Vector and Symbolic Processors.

Memory Hierarchy Technology: Hierarchical Memory Technology Inclusion, Coherence and Locality, Memory Capacity Planning.

Section C

Multiprocessor System Interconnects: Hierarchical Bus system, Crossbar Switch and Multiport Memory, Multistage and Combining networks.

Cache Coherence and Synchronization Mechanism: The Cache coherence problem, Snoopy bus protocol, Hardware Synchronization Mechanisms.

Vector Processing principles: Vector Instruction Types, Vector Access Memory Schemes.

Multivector Multiprocessors: Performance Directed Design rules, Cray Y – MP, C-90 and NTP

SIMD Computer Organization: Implementation Models, The CM-2 Architecture.

Section D

Software for parallel Programming: Shared variable Model, Message Passing Model, Data parallel Model, Function and Logic Models.

Parallel Language and Compilers: Language feature for parallelism, Parallel language Constructs, Optimizing Compiler for parallelism.

Parallel Programming Environment: Software tools and environment, Y-MP, Pargon and CM-5 Environment, Visualization and Performance Testing.

Synchronization and Multiprocessing Modes: Principles of synchronization, Multiprocessor execution Models, Shared-Variable Program Structures, Locks for protected access, Semaphores and Applications, Monitors and Application, Message-passing program Development, Distributing the Computation, Synchronous Message passing, Asynchronous message passing.

Mapping Programs on to Multicomputers: Domain Decomposition Techniques, Control Decomposition techniques, Heterogeneous Processing.

Books: -

1. Kai Hawang: Advance Computer Architecture – Parallelism, Scalability and Programmability, McGraw Hill International Edition, Computer Series 1993.
2. Michael J. Quinn: Parallel Computing – Theory and Practice, McGraw Hill International Edition, Computer Science Series, 2nd Edition, 1994.
3. S. G. Akl: Design and Analysis of parallel algorithms, Prentice Hall, Englewood Cliff NJ.
4. S. Lakshmivarahan and S. K. Dhail: Analysis and Design of Parallel Algorithms-arithmetic and Matrix Problems, McGraw Hill International Edition, Computer Science Series.1990.
5. A practical approach to parallel Computing by S.K. Ghosal, University press (India) Ltd.