INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Department of Computer Science and Engineering

Subject Code: CSC-503 **Course Title**: Distributed Systems

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PCC

Course Outlines: Introduction. TCP and UDP servers design. Theoretical foundations – time and global state. Distributed mutual exclusion. Distributed deadlock handling. Consensus and related problems. Checkpointing and fault recovery. Replication and voting protocols. Distributed file systems.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Department of Computer Science and Engineering

Subject Code: CSC-505 **Course Title**: Machine Learning

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PCC

Course Outlines: Machine learning techniques – Introduction to supervised learning techniques and un-supervised learning techniques, dimension reduction, feature representation, regression, gradient descent, learning rate, supervised learning – binary-class and multi-class classification, bias, variance, regularization, performance metrics – precision, recall, accuracy, F1 score, unsupervised learning – k-means clustering, discriminative versus generative models, Bayes theorem, conditional independence, decision trees, recent applications of machine learning

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Department of Computer Science and Engineering

Subject Code: CSL-512 **Course Title:** Formal Methods and Software Verification

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PEC

Course Outlines: Modelling Concurrent Systems, Linear-Time Properties, Safety Properties and Invariants, Regular Properties, Automata on Infinite Words, Linear Temporal Logic: syntax and semantics, Computation Tree Logic: syntax and semantics, Expressiveness of CTL vs. LTL, CTL model checking, Symbolic model checking.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Department of Computer Science and Engineering

Subject Code: CSL-523 **Course Title:** Computational Geometry

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PEC

Course Outlines: Geometric Problems and Geometric Algorithm Design Paradigms - Greedy, Line or Plane Sweep, Divide and Conquer, Incremental; Polygon Triangulation - Triangulation Theory, Art Gallery Problem; Polygon Partitioning - Monotone Partitioning, Trapezoidalization, Convex Partitioning; Convex Hulls in Two Dimensions: Gift Wrapping, Quick Hull, Graham's Scan Algorithms; Voronoi Diagrams, Delaunay Triangulations, Arrangements, Point-Line Duality, Search and Intersection; Motion Planning - Configuration Space, Funnel Algorithm.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Department of Computer Science and Engineering

Subject Code: CSC-501 **Course Title:** Advanced Algorithms

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PCC

Course Outlines: Dynamic programming, greedy algorithms, amortised analysis. Graph algorithms: minimum spanning trees, single-source shortest paths, all pair shortest paths, flow networks, Ford-Fulkerson method. NP-completeness. Approximation algorithms. Randomised algorithms and multithreaded algorithms.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Computer Science and Engineering

Subject Code: CSL-540 **Course Title:** Modern Processor Design and Optimization

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PEC

Course Outlines: Computer fundamentals, Modern computer architectures, In-order pipelines, Out-of-order pipelines, Pipeline design, Hazards, Overview and design of muti threaded and multi core CPUs, Cache memory design in multicore systems, Main memory controller, Architectural optimizations for power management and reliability, Secure architectures and side-channel attack, Architectural design of Neural Networks, Graphic processors.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Computer Science and Engineering

Subject Code: CSL-506 **Course Title:** Program Analysis and Testing

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PEC

Course Outlines: Introduction to program analysis, LLVM intermediate representation, Control-flow analysis, Dataflow analysis, Pointer analysis, Abstract Interpretation, Automated software testing, Symbolic Execution, Fuzzing, Bug localization and program repair. Data and Machine Learning driven program analysis.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Computer Science and Engineering

Subject Code: CSL-555 **Course Title:** Complexity Theory

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PEC

Course Outlines: Review of Turing Machine (TM) and its variants, Universal Turing Machines and encoding of Turing machines, Uncomputability, Complexity Classes P and NP, P vs NP, Reducibility, NP-completeness, Time-hierarchy theorem, Limits of diagonalization, Space Complexity, The Polynomial Hierarchy, Boolean Circuits, Uniformly generated circuits, Turing machines that take advice, , Circuit Lower Bounds, Complexity Classes NC and AC, Probabilistic Turing machines, One-sided and two sided errors: complexity classes RP, coRP and ZPP, Error-reduction in randomized computation, Randomized space-bounded computation.