M. Tech. (Computer Science and Engineering)

CURRICULUM

(w.e.f. 2022-23)

DEPARTMENT OF COMPUTER SCIENCE

Course Structure

SEMESTER I						
Course Type	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
DSC	CSC-411	Parallel and Distributed Computing	3		1	4
DSC	CSC-412	Combinatorics and Graph Theory	3		1	4
DSE/GE		From List of Electives of Computer science/Others				4
DSE/GE		From List of Electives of Computer science/Others				4
DSE/GE		From List of Electives of Computer science/Others				4
					Total Credits	**20**
SEMESTER II						
Course Type	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
DSC	CSC-461	Advanced Algorithms	3		1	4
DSC	CSC-462	Research Methodology	3	1		4
DSE/GE		From List of Electives of Computer science/Others				4
DSE/GE		From List of Electives of Computer science/Others				4
DSE/GE		From List of Electives of Computer science/Others				4
					Total Credits	**20**
SEMESTER III						
Course Type	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
DSCP	CSP-511	Research Seminar	4			4
DSCP	CSP-512	Dissertation part 1			16	16
					Total Credits	**20**

SEMESTER X						
Course Type	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
DSCP	CSP-561	Dissertation part 2			20	20
Total credits 80 for award the degree of M. Tech. in Computer Science & Engineering			**Total Credits**			**20**

Electives can be taken from list of Electives or MOOC courses approved by authority.

List of Electives:

Course Code	**Course Title**	**L**	**T**	**P**	**C**
CSE-101	Big Data Analytics	3		1	4
CSE-102	Business Intelligence	3		1	4
CSE-103	Introduction to IOT	3		1	4
CSE-104	Modeling and Simulation	3		1	4
CSE-105	Operation Research	3	1		4
CSE-106	Biometrics	3	1		4
CSE-107	Computer Vision and Pattern Recognition	3		1	4
CSE-108	Digital Image Processing	3		1	4
CSE-109	Introduction to Cloud Computing	3		1	4
CSE-110	Natural Language Processing	3		1	4
CSE-111	Introduction to Data Science	3		1	4
CSE-112	Digital Marketing	3		1	4
CSE-113	Fuzzy Logic	3		1	4
CSE-114	Data Mining and Warehousing	3		1	4

CSE-115	Digital Signal Processing	3		1	4
CSE-116	Probability and Statistical Inference	3	1		4
CSE-117	Cryptography and Network Security	3		1	4
CSE-118	Advanced Algorithms	3		1	4
CSE-119	Information Theory and Coding	3	1		4
CSE-120	Machine Learning	3		1	4
CSE-121	Neural Networks	3		1	4
CSE-122	Mobile Ad-hoc Networks	3		1	4
CSE-123	Cloud Architecture	3		1	4
CSE-124	Parallel and Distributed Computing	3		1	4
CSE-125	Advanced Graph Theory	3	1		4
CSE-126	Cyber Forensics	3	1		4
CSE-127	Software Defined Networks	3	1		4
CSE-128	Evolutionary Algorithms	3		1	4
CSE-129	Block chain Technology	3		1	4
CSE-130	Quantum Computing	3	1		4
CSE-131	Research Methodology	4			4
CSE-132	Cloud Security	3	1		4

This list may be appended from time to time.

Learning Outcomes

M.Tech. Computer Science and Engineering

- **PO1.** Communicate computer science concepts, designs, and solutions effectively and professionally.
- **PO2.** Apply computer science theory and software development concepts to produce effective designs and solutions for specific problems.
- **PO3.** Identify, analyze, and synthesize scholarly literature relating to the field of

computer science.

Syllabus

(Semester I – Semester IV)

SEMESTER I

CSC-411: Parallel and Distributed Computing **L | T | P (3 | 0 | 1)**

Prerequisites: Operating System, Computer Hardware and Networking

Course Outcome: By the end of the course, students should be able to:

- Understand the terminologies in distributed computing
- Understand the different type of Processors, single as well multi-core processors
- Understand the concepts of computational Grids.

Introduction: Parallel Computing Architectures, Paradigms, Issues, & Technologies, architectures, topologies, organizations, Parallel Programming Using Shared Memory, memory coherence, race conditions and deadlock detection, synchronization, multithreaded programming, Parallel Programming using Message Passing, synchronous/asynchronous messaging, partitioning and load-balancing.

Advanced Processors and Interconnects: Multicore Processors and High-bandwidth Networks, Parallel and distributed architectures, Distributed and parallel algorithms, Fundamental problems in parallel and distributed computing, fundamental concepts and reasoning principles for parallel and distributed computer systems.

Distributed Programming Algorithms: Fundamental issues and concepts, synchronization, mutual exclusion, termination detection, clocks, event ordering, locking, CORBA, JavaRMI, Web Services, shared spaces.

Clusters of Computers: Server Clusters, High Availability, and Disaster Recovery, synchronization, fault tolerance, coordination and consensus, Virtual Machines and Virtualized Datacenters.

Peer-to-Peer Computing: P2P systems, Familiarity with concurrent programming primitives (semaphores, locks, monitors), Overlay networks, and Content Distribution.

Computational Grids and Applications: National or global computing Grids and Applications.

Textbooks:

1. M J Quinn, Parallel Programming in C with MPI and OpenMP.
2. AnanthGrama, George Karypis, Vipin Kumar, and Anshul Gupta, Introduction to Parallel Computing, 2nd ed., 2003.
3. David Kirk, Wen-Mei W. Hwu, Wen-meiHwu, Programming Massively Parallel Processors: a hands-on approach, Morgan Kaufmann, 2010.
4. William Gropp, Ewing Lusk, and Anthony Skjellum, Using MPI: Portable Parallel Programming with the Message-Passing Interface, 2nd ed., 1999.
5. Norm Matloff, Programming on Parallel Machines: GPU, Multicore, Clusters and More.
6. K. Hwang and Z. Xu, Scalable Parallel Computing, McGraw-Hill, 1998.

7. G. Coulouris, J. Dollimore, Distributed Systems Concepts and Design, Addison Wesley.
8. Ian Taylor: From P2P to Web Services and Grids, Springer-Verlag, 2005.
9. F. Berman, G. Fox, and T. Hey (Editors), Grid Computing, Wiley, 2003.

Hariri and Parashar, Tools and Environments for Parallel & Distributed Computing, John Wiley, 2004.

CSC-412: Combinatorics and Graph Theory **L | T | P (3 | 0 | 1)**

Elementary Concepts in Combinatorics: Basic counting principles, Binomial theorem; Bijective proofs, Combinatorial identities, Permutations of multisets, Multinomial Theorem, Combinations of Multiset, Sterling's Formula, Generalization of Binomial coefficient, Pigeon hole principle and resolution refutation lower bound. Double counting, Matching and Hall's theorem, Inclusion exclusion principle, Inclusion exclusion principle. Solving recurrence relations using generating functions, Partition Number, Catalan Numbers, Sterling numbers of the 2nd kind, Difference Sequences.

Graph Theory: Matchings, Path Cover, Connectivity, Vertex Coloring, Edge Coloring, Other Coloring Problems, Perfect graphs, Planar Graphs, Other special classes of Graphs. Network flow, Introduction to Minor Theory,

The Probabilistic Method: Basics, Markov, Chebishey Inequalities, Lovaz Local Lemma, Linearity of Expectation; The deletion method; The entropy function; Random walks and randomized algorithm for CNF formulas, Random graph.

Spectral Graph theory: Basic properties of graph spectrum; Cheeger's inequality and approximation of graph expansion; Expander graphs and applications to super concentrators and pseudo randomness; Error correcting codes and expander codes; Small set expansion, Unique Games Conjecture and Hardness of approximation.

Additive Combinatorics: Sum product theorem, Szemeredi-Trotter theorem, Kakeya set problem and applications to randomness extractors.

Textbooks:

1. Statys Jukna, Extremal Combinatorics: With Applications in Computer Science, Springer, 2nd ed., 2013.
2. R.P. Grimaldi, B.V. Ramana, Discrete and Combinatorial mathematics – An applied introduction, Pearson Education (2007).
3. Richard A Brnaldi, Introductory Combinatorics, Pearson Education, Inc. (2004).
4. Miklos Bona, Introduction to Enumerative Combinatorics, McGraw Hill (2007).
5. A walk through Combinatorics – An introduction to enumeration and graph theory, World Scientific Publishing Co. Pvt. Ltd. (2006).
6. J.H. Vanlint, R.M. Wilson, A course in Combinatorics, Cambridge University Press.
7. R. Diestel, "Graph Theory", Springer, 2nd ed., 2000.
8. N. Alon and J. Spenser, "Probabilistic Methods", John Wiley and Sons, 2nd ed., 2000.

SEMESTER II

CSC-461: Advanced Algorithms **L | T | P (3 | 0 | 1)**

Prerequisites: Data structures and algorithms.

Course Outcomes: By the end of the course, students will be able to

- Understand the necessary mathematical abstraction to solve problems.
- Come up with analysis of efficiency and proofs of correctness.
- Comprehend and select algorithm design approaches in a problem specific manner.

Course Outline:

Review of Analysis Techniques, Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations, Master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

Advanced Data Structures: Red Black Trees, B-Tree, Augmenting Data Structure, Priority Queues, Binomial Heap, Fibonacci Heap, Mergeable Heaps, Data Structure for Disjoint Sets and Union-Find Algorithm.

String Matching Algorithms: Naïve String Matching, Rabin-Karp, String matching with finite automata, Knuth-Morris-Pratt (KMP) Algorithm, Boyer–Moore algorithm.
Number Theoretic Algorithms: Factorization, GCD, Modular Arithmetic, Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization.

Graph Algorithms: Bellman-Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching.

Probabilistic algorithms; Randomizing deterministic algorithms, Randomized Quicksort, Algorithms for Computational Geometry problems, Convex Hull. Approximation Algorithms, Polynomial Time Approximation Schemes.

Textbooks:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd ed., Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.
3. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd ed., Universities press, 2007.

CSC-462: Research Methodology **L | T | P (3 | 1 | 0)**

Prerequisites: NIL

Course Outcome: By the end of the course, students should be able to:

- Understand the concept of research.
- Understand the concept of data collection and selection for research.
- Understand the applicability of research for public at large.

Introduction to Research Methods in science – Philosophy of Science, Research methods and Creative Thinking, Evolutionary Epistemology, Scientific Methods, Hypotheses Generation and Evaluation, Code of Research Ethics, Definition and Objectives of Research, Various Steps in Scientific Research, Research presentations Types of Research – Research Purposes – Research Design – Survey Research – formulation of scientific problems and hypotheses –selection of methods for solving a scientific problem Case Study Research.

How to perform a literature review – Sampling Methods – Data Processing and Analysis strategies - Data Analysis with Statistical Packages – Statistical Analysis – Hypothesis-testing – Generalization and Interpretation.

Research Reports - Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report – Requirements of a good dissertation.

Textbooks:

1. Oates, B.J., (2005). Researching Information Systems and Computing. Sage Publications, UK.
2. Zobel, J. (2004). Writing for Computer Science - The art of effective communication. 2nd ed., Springer, UK.
3. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
4. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
5. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology.

SEMESTER III

CSP-462: Research Seminar **L | T | P (0 | 0 | 4)**

Prerequisites: NIL

Course Outcome: By the end of the seminar, students should be able to:

- Understand the concept of research
- Describe and present the literature study and research gaps identified.
- Improving written and communication skills

All the students, will prepare presentation for research seminar which includes their research topic and literature survey.

CSP-462: Dissertation-Part 1 **L | T | P (0 | 0 | 16)**

Prerequisites: NIL

Course Outcome: By the end of the Dissertation-Part 1, students should be able to:

- Formulate the research objectives
- Design the framework/architecture of the proposed work
- Demonstration of research tools

SEMESTER IV

CSP-462: Dissertation-Part 2 **L | T | P (0 | 0 | 20)**

Prerequisites: NIL

Course Outcome: By the end of the Dissertation-Part 2, students should be able to:

- Design and implement the proposed framework/architecture of the proposed work
- Research paper writing and publishing
- Dissertation report