

Curriculum of M.Tech Programme in Computer Science and Engineering

Highlights

- The M.Tech programme shall be structured on a credit-based system following the semester pattern having continuous evaluation.
- Each programme will consist of
 - Core courses (Discipline core courses and Programme core courses)
 - Elective courses (Programme electives and Industry/ Interdisciplinary electives)
 - Audit course
 - MOOC
 - Research Methodology & IPR
 - Mini-project
 - Laboratory work
 - Dissertation/ Research project work

Semester wise distribution of the courses

Semester I (M1)

Slot	Course Type	Course No	Course	Marks		Hours L - T - P	Credits
				CIA	ESE		
A	DCC	22MA060A	Mathematical Foundations of Computing Systems	40	60	3 - 0 - 0	3
B	PCC	22CS161A	Parallel Computer Architecture	40	60	3 - 0 - 0	3
C	PCC	22CS161B	Advanced Data Structures and Algorithms	40	60	3 - 0 - 0	3
D	PEC	22CS1XXX	Program Elective 1	40	60	3 - 0 - 0	3
E	PEC	22CS1XXX	Program Elective 2	40	60	3 - 0 - 0	3
S	RM	22MC161A	Research Methodology & IPR	40	60	2 - 0 - 0	2
T	LBC	22CS169A	Algorithm Design Laboratory	100	-	0 - 0 - 2	1
Total				340	360	19	18

Teaching Assistance: 6 hours

Semester II (M2)

Slot	Course Type	Course No	Course	Marks		Hours L - T - P	Credits
				CIA	ESE		
A	DCC	22CS160A	Advanced Computer Networks	40	60	3 - 0 - 0	3
B	PCC	22CS161C	Topics in Database Technology	40	60	3 - 0 - 0	3
C	PEC	22CS1XXX	Program Elective 3	40	60	3 - 0 - 0	3
D	PEC	22CS1XXX	Program Elective 4	40	60	3 - 0 - 0	3
E	IEC	22CS1XXX	Industry/Interdisciplinary Elective	40	60	3 - 0 - 0	3
S	PR	22CS167A	Mini project	100	-	0 - 0 - 4	2
T	LBC	22CS169B	Network Systems Lab	100	-	0 - 0 - 2	1
			Total	400	300	21	18

Teaching Assistance: 6 hours**Semester III (M3)**

Slot	Course Type	Course No	Course	Marks		Hours L - T - P	Credits
				CIA	ESE		
TRACK 1							
A*	MOOC		MOOC	To be successfully completed		-	2
B	AC	22AC071A	Audit Course	40	60	3 - 0 - 0	-
C	PR	22CS178A	Internship	50	50	-	3
D	PR	22CS178B	Dissertation Phase I	100	-	0 - 0 - 17	11
TRACK 2							
A*	MOOC		MOOC	To be successfully completed		-	2
B	AC	22AC171A	Audit Course	40	60	3 - 0 - 0	-
C	PR	22CS178A	Internship	50	50	-	3
D	PR	22CS178B	Research project Phase I	100	-	0 - 0 - 17	11
			Total	190	110	20	16

Teaching Assistance: 6 hours

*MOOC must be successfully completed before the commencement of fourth semester. This course can be carried out at any time from M1 to M3.

Semester IV (M4)

Slot	Course Type	Course No	Course	Marks		Hours L - T - P	Credits
				CIA	ESE		
TRACK 1							
D	PR	22CS178C	Dissertation Phase II	100	100	0 - 0 - 24	16
TRACK 2							
D	PR	22CS178C	Research project Phase II	100	100	0 - 0 - 24	16
Total				100	100	24	16

Teaching Assistance: 5 hours

Program Elective courses

#	Course code	Course Name
1.	22CS162A	Data Mining & Warehousing
2.	22CS162B	Data Compression Techniques
3.	22CS162C	Advanced Topics in Distributed Systems
4.	22CS162D	Image and Video Processing
5.	22CS162E	Semantic Web Technology
6.	22CS162F	Principles of Information and Network Security
7.	22CS162G	Number Theory and Cryptology
8.	22CS162H	Parallel Algorithms
9.	22CS162I	Soft Computing Techniques in Bioinformatics
10.	22CS162J	Computational Geometry
11.	22CS162K	Advanced Compiler Design
12.	22CS162L	Fuzzy set Theory and Applications
13.	22CS162M	Applied Machine Learning
14.	22CS162N	Advanced Graph Theory
15.	22CS162O	Essentials of Cyber Security
16.	22CS162P	Information Retrieval
17.	22CS162Q	Block Chain
18.	22CS162R	Network on Chip
19.	22CS162S	Natural Language Processing

Interdisciplinary courses

#	Course code	Course Name	Offering Department
1.	22CS165A	Pattern Recognition	CSE
2.	22CS165B	Cloud computing and security	CSE
3.	22CS165C	Data Science	CSE
4.	22CS165D	Machine Learning	CSE

DRAFT

1) Core courses in M1

#	Course category	Course code	Course Name	Credits
A	DCC	22MA060A	MATHEMATICAL FOUNDATIONS OF COMPUTING SYSTEMS	3

Brief syllabus

Classes of parallelism and parallel architecture, computer architecture design issues, Performance measurements, quantitative principles of computer design, Instruction level parallelism concepts and challenges, Data dependencies and hazards, Basic compiler techniques for exposing ILP. Dynamic Scheduling-Tomasulo's approach, Hardware based speculation, ILP using multiple issues and static scheduling, ILP using dynamic scheduling, multiple issue and speculation, case study- Intel Core i7. Data level parallelism-Vector architecture - Vector instruction types, Vector-Access memory schemes. Super scalar processors, VLIW processors, vector processing and array processing. Basic concepts of GPU and CUDA programming. Organization of GPU based systems. Multiprocessor system interconnects-hierarchical bus system, Crossbar switch and multiport memory, multistage networks, Centralized shared memory architecture, Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations, distributed shared memory and Directory based coherence. Concept of multithreading and hyper-threading.

#	Course category	Course code	Course Name	Credits
B	PCC	22CS161A	PARALLEL COMPUTER ARCHITECTURE	3

Brief syllabus

Classes of parallelism and parallel architecture, computer architecture design issues, Performance measurements, quantitative principles of computer design, Instruction level parallelism concepts and challenges, Data dependencies and hazards, Basic compiler techniques for exposing ILP. Dynamic Scheduling-Tomasulo's approach, Hardware based speculation, ILP using multiple issues and static scheduling, ILP using dynamic scheduling, multiple issue and speculation, case study- Intel Core i7. Data level parallelism-Vector architecture-Vector instruction types, Vector-Access memory schemes. Super scalar processors, VLIW processors, vector processing and array processing. Basic concepts of GPU and CUDA programming. Organization of GPU based systems. Multiprocessor system interconnects-hierarchical bus system, Crossbar switch and multiport memory, multistage networks, Centralized shared memory architecture, Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations, distributed shared memory and Directory based coherence. Concept of multithreading and hyper-threading.

#	Course category	Course code	Course Name	Credits
C	PCC	22CS161B	ADVANCED DATA STRUCTURES AND ALGORITHMS	3

Brief syllabus

Amortized Analysis – aggregate, accounting and potential methods. Advanced data structures: binomial heap, Fibonacci heap, disjoint sets - applications. Number-Theoretic algorithms: maxflow-min-cut theorem, String matching: Overview of Complexity Classes Probabilistic algorithms: Numerical algorithms Las Vegas algorithms, Complexity classes in randomized algorithms – RP, PP, ZPP, BPP. Geometric Algorithms.

#	Course category	Course code	Course Name	Credits
T	LBC	22CS169A	ALGORITHM DESIGN LABORATORY	1

Brief syllabus

Advanced data structures: binomial heap, Fibonacci heap, disjoint sets, String matching algorithm, Randomized algorithms, Geometric Algorithms, Network flow algorithms, Integer factorization, Primality testing.

2) **Core courses in M2**

#	Course category	Course code	Course Name	Credits
A	DCC	22CS160A	ADVANCED COMPUTER NETWORKS	3

Brief syllabus

Network Architecture - Internet Protocol - Packet switching- Internetworking devices-- Switching basics- Routers-Path Vectors and policies-Congestion Management - -Quality of Service - Peer to Peer Networks - Virtual Private Networks and tunnels –Network management-installation and maintenance

#	Course category	Course code	Course Name	Credits
B	PCC	22CS161C	TOPICS IN DATABASE TECHNOLOGY	3

Brief syllabus

Transaction Processing, Concurrency Control, Recovery. Query Processing & Optimization. Parallel and Distributed Database, Active Database, Temporal and Spatial Databases, Deductive Database, Object Oriented Database, Advanced Applications.

#	Course category	Course code	Course Name	Credits
T	LBC	22CS169B	Network Systems Lab	2

Brief syllabus

Familiarization of Linux/Unix network commands, Familiarization of Wireshark ,Detailed Study of protocols in TCP/IP model using Wireshark, Deploy Server services, Network administration and defence, Socket Programming Experiments

Syllabus of Program Elective courses

#	Course code	Course Name
	22CS162A	DATA MINING & WAREHOUSING

Brief syllabus

Data warehousing – OLAP, schema, Data architecture, Data Mining. Mining Tasks, Issues, Metrics, KDD Vs Data mining, DMQL, Classification Clustering, Association, Web mining, Spatial mining, temporal mining

#	Course code	Course Name
	22CS162B	DATA COMPRESSION TECHNIQUES

Brief syllabus

Speech Compression & Synthesis, Image Compression, Video Compression, Fractal techniques

#	Course code	Course Name
	22CS162C	ADVANCED TOPICS IN DISTRIBUTED SYSTEMS

Brief syllabus

Distributed System: System Architecture, Processes, Threads, Code migration, Communication, Naming, Hadoop: Map and Reduce, Hadoop Distributed File System, Map Reduce Types, Administering Hadoop, Distributed Algorithms: Causality, Modeling a Distributed Computation, Synchronization and Election, Distributed Mutual Exclusion, Algorithms in General Synchronous Networks.

#	Course code	Course Name
	22CS162D	IMAGE & VIDEO PROCESSING

Brief syllabus

Image processing techniques – enhancement – restoration – segmentation - object recognition - image compression - morphological image processing and video processing.

#	Course code	Course Name
	22CS162E	Semantic Web Technology

Brief syllabus

Introduction to Semantic Web, RDF and RDF schema, SPARQL, Web Ontology Language, formal semantics, Description logic, automated reasoning, ontology rules and queries, ontology engineering, software tools and applications.

#	Course code	Course Name
	22CS162F	PRINCIPLES OF INFORMATION AND NETWORK SECURITY

Brief syllabus

Security Concepts, Security Models, Access control mechanisms, Attacks, Threats, Software vulnerabilities, Malwares, Cryptography Topics: El-Gamal encryption, Biometric Authentication, Network Security – IPsec, TCP/IP vulnerabilities, Firewalls, Wireless Security.

#	Course code	Course Name
	22CS162G	NUMBER THEORY AND CRYPTOLOGY

Brief syllabus

Mathematical Concepts of Cryptography, Modular Arithmetic, Introduction to Number Theory, Classical Encryption Techniques, DES, AES, Public Key Cryptography, Elgamal Cryptographic System, TransportLevel Security, System Security, Firewalls.

#	Course code	Course Name
	22CS162H	PARALLEL ALGORITHMS

Brief syllabus

Models of Parallel Computation: SIMD, MIMD, PRAM (EREW, CREW, CRCW), Performance Measures, Performance metrics, Interconnection Architectures, Basic Parallel Algorithmic Techniques, PRAM Algorithms, Sorting, Searching and Merging, Matrix operations, Graph Algorithms, Parallel Complexity (Lower bounds, NC Class and P-Completeness).

#	Course code	Course Name
	22CS162I	SOFT COMPUTING TECHNIQUES IN BIOINFORMATICS

Brief syllabus

The central dogma of molecular biology, Sequence alignment, Scoring matrices, Fuzzy sets, relations & logics, Hidden Markov Models, Artificial Neural Networks, Genetic Algorithm.

#	Course code	Course Name
	22CS162J	COMPUTATIONAL GEOMETRY

Brief syllabus

Geometric Preliminaries, Data Structures for geometric problems, Geometric Searching, applications, Range Searching using Kd-trees, Convex Hulls, Triangulation, Voronoi Diagrams, Delaunay Triangulation, Introduction to Visibility Problems, Visibility graph.

#	Course code	Course Name
	22CS162K	ADVANCED COMPILER DESIGN

Brief syllabus

Control Flow Analysis, Data Flow Analysis, Dependence analysis & Dependence graphs, Alias analysis, Global Optimizations, Redundancy Elimination, Loop Optimizations, Procedure Optimization techniques, Machine Dependent tasks, Low Level Optimization techniques, Introduction to inter-procedural analysis and optimization, Introduction to Affine Transform Theory.

#	Course code	Course Name
	22CS162L	FUZZY SET THEORY AND APPLICATIONS

Brief syllabus

Classical & Fuzzy Sets, Relations – Properties and Operations, Fuzzy Membership Functions, Defuzzification to Scalars, Classical Logic, Fuzzy Logic, Applications of Fuzzy Systems.

#	Course code	Course Name
	22CS162M	APPLIED MACHINE LEARNING

Brief syllabus

Classification, Regression, Support Vector Machines, Artificial Neural Networks, Hidden Markov models, Decision Tree, Ensemble classification, Clustering ,Case studies

#	Course code	Course Name
	22CS162N	ADVANCED GRAPH THEORY

Brief syllabus

Graphs, Connectivity and Hamiltonicity, Connectivity, The Center and Edge connectivity- Self Central Graphs - The Median – Central Paths - Other Generalized Centers, Extremal Distance Problems, Distance sequences, Matrices, Symmetry, Digraphs, Graph Algorithms, Critical Path Method.

#	Course code	Course Name
	22CS1620	ESSENTIAL OF CYBER SECURITY

Brief syllabus

Cyber Security Fundamentals- Attacker Techniques and Motivations- Malicious Code- Securing Devices- Defense and Analysis Techniques

#	Course code	Course Name
	22CS162P	INFORMATION RETRIEVAL

Brief syllabus

Introduction to the Concepts of Information Retrieval, Retrieval models, Text processing, Text representation, Text categorization and clustering, Experimental evaluation of Information Retrieval system, Searching the web, Applications to information filtering, Recommender Systems.

#	Course code	Course Name
	22CS162Q	BLOCK CHAIN TECHNOLOGIES AND ITS APPLICATIONS

Brief syllabus

Need for Distributed Record Keeping, Modeling faults and adversaries, Basic Distributed Computing, Basic Crypto primitives, Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Privacy, Security issues in Blockchain

#	Course code	Course Name
	22CS162R	NETWORK ON CHIP

Brief syllabus

Basic Concepts of Network-on-Chip- Flow Control and Deadlock- Router Micro-architecture- Network Performance Analysis and Reliability- NoC Based System Integration

#	Course code	Course Name
	22CS162S	NATURAL LANGUAGE PROCESSING

Brief syllabus

Introduction to Natural Language Processing, Statistical Modelling and Classification
Finite State methods Grammar for Natural Language Processing; Syntax Parsing; Context-Free Grammars for English; Sentence-level constructions; Text Mining: Named Entity Recognition, Categorization – Information Extraction ; Clustering- Hierarchical Clustering Document Classification and routing; Document Summarization; Sentiment Analysis; Opinion Mining, Basic Rules of Opinions and Compositional Semantics; Polysemy and synonymy, Word Sense Disambiguation, Coreference resolution; handling sparsity, domain adaptation and representations; Markov logic and NLP; Generic Issues: Multilinguality, Multimodality, Text and Images – Modality Integration -: Machine Translation Discourse Processing; Case Study: Lemmatization, Stemming, Tokenization and Tagging using NLTK Tool Kit

Interdisciplinary courses

#	Course code	Course Name
	22CS165A	Pattern Recognition

Brief Syllabus

Review of Probability Theory and Probability distributions, Introduction to Pattern Recognition and its applications, Bayesian decision theory, Bayesian estimation: Gaussian distribution, ML estimation, EM algorithm, Supervised and unsupervised learning, Feature selection, Linear Discriminant Functions, Non-parametric methods, Hidden Markov models for sequential data classification, Linear models for regression and classification, Clustering

#	Course code	Course Name
	22CS165B	Cloud computing and security

Brief Syllabus

Cloud Computing, History of Cloud Computing, Cloud Architecture, Disadvantages of Cloud Computing, Cloud Services, Types of Cloud Service Development, Centralizing Email Communications, Schedules, To-Do Lists, Contact Lists, Group Projects and Events, Calendars, Schedules and Task Management, Contact Management, Project Management, Databases, WebBased Communication Tools, Web Mail Services, Social Networks and Groupware, Blogs and Wikis

#	Course code	Course Name
	22CS165C	Data Science

Brief Syllabus

Data Science process, Memorization methods, Unsupervised models, Univariate data exploration, Data visualisation, Prediction and filtering, Probability theory and Statistics.

#	Course code	Course Name
	22CS165B	Machine Learning

Brief Syllabus

Classification, Regression, Support Vector Machines, Artificial Neural Networks, Hidden Markov models, Decision Tree, Ensemble classification, Clustering , Case studies