

Curriculum and Syllabus

**Masters of Technology (M. Tech.)
Computer Science and Engineering
(Applicable for 2026-27 batch and onwards)**



**Department of Computer Science and Engineering
School of Engineering and Technology,
H. N. B. Garhwal University, Srinagar Garhwal,
Uttarakhand (246174)**

M. Tech. Two-Year Program (NEP 2026)

Curriculum

Semester	Course Category	Course Title	Credits		Total Credit
			T	P	
1 st	Discipline Specific Core [DSC]	Advance Data Structures & Algorithms SET/CSE/MT/DSC/C101	3	2	5
		Mathematical Foundation of Computer Science SET/CSE/MT/DSC/C102	3	2	5
		Advance Computer Organization and Architecture SET/CSE/MT/DSC/C103	5	-	5
	SEC/ Vocational	Internet Of Things SET/CSE/MT/SEC/C104	5	-	5
	Discipline Specific Elective [DSE]	Bioinformatics / Blockchain Technology/ Natural Language Processing	3	1	4
	Or				
	Multi-Disciplinary Elective [MDE]	Research Methodology SET/CSE/MT/MDE/C108	4	-	4
	AEC/VAC (Non-CGPA Course)	Indian Knowledge System	1	-	-
	Total				24

Semester	Course Category	Course Title	Credits		Total Credit
			T	P	
2 nd	Discipline Specific Core [DSC]	Advanced Database Management System SET/CSE/MT/DSC/C201	3	2	5
		Wireless and Mobile Communication SET/CSE/MT/DSC/C202	5	-	5
		Cryptography and Network Security SET/CSE/MT/DSC/C203	5	-	5
	SEC/ Vocational	Advanced Compiler Design SET/CSE/MT/SEC/C204	3	2	5
	Discipline Specific Elective [DSE]	Pattern Recognition/Cloud Computing/ Soft Computing	3	1	4
	Or				
	Multi-Disciplinary Elective [MDE]	Quantum Computation SET/CSE/MT/MDE/C208	3	1	4
	AEC/VAC (Non-CGPA Course)	Constitutional, Ethical, and Moral Values	1	-	-
	Total				24

Semester			Credits		
	Course Category	Course Title	T	P	Total Credit
3 rd	Discipline Specific Core [DSC]	Advanced Operating System SET/CSE/MT/DSC/C301	3	2	5
		Seminar SET/CSE/MT/DSC/C302	-	5	5
		Dissertation Phase (I) SET/CSE/MT/DSC/C303	-	10	10
	Discipline Specific Elective [DSE]	Modelling and Simulation/ Computer Network Administration/Grid Computing	3	1	4
	Or				
	Multi-Disciplinary Elective [MDE]	Genetic Algorithm & Applications SET/CSE/MT/MDE/C307	3	1	4
	SEC (Non-CGPA Course)	SEC- Academic Library Systems and Services or Entrepreneurship & Start-up Awareness	1	-	-
	Total				24

Semester			Credits		
	Course Category	Course Title	T	P	Total Credit
4 th	Discipline Specific Core [DSC]	Thesis & Dissertation Phase (II) SET/CSE/MT/DSC/C401	-	24	24
	SEC (Non-CGPA Course)	SEC-Community Outreach Activities	1	-	-
					24

Semester 1

Advanced Data Structures and Algorithms- SET/CSE/MT/DSC/C101	
Module Name	Content
Introduction to data structure and Algorithms:	Overview of Data Structure: pointers, parameters passing, templates, using Matrices, Algorithm Analysis: Basics of Time Complexity Estimates, General norms for running time calculation.
Lists, Stacks & Queues:	Abstract Data Types, Representation & implementation of ADT list, doubly linked list, Circular linked lists, Representation, Implementation and applications of ADT stack and Queue.
Trees:	Implementation of traversal of trees, Binary Trees and Binary Search Trees in C, Concepts of AVL Trees, Splay Trees and B-Trees. Hash Function, Separate Chains, Open Addressing, Rehashing, Extendible Hashing.
Internal Sorting Algorithms:	Sorting like Insertion Sort, Shell Sort, Heap Sort, Merge Sort, Quick Sort and Simple External Sorting Algorithm.
Graph Algorithms:	Representation of Graph Topological Sort, Shortest-Path Algorithm, Network Flow Problem, Minimum Spanning Tree Algorithm, Applications of Depth – First Search, Introduction to NP-Completeness.
Textbooks:	Data Structures & Algorithm Analysis in C++, Mark Allen Weiss. Second edition, Pearson Edition. Asia. Data Structure, Algorithm and OOP, Gregory L. Heileman (Tata Mc Graw Hill Edition).
Practical - SET/CSE/MT/DSC/C101 Advanced Data Structures & Algorithms	
Prerequisites: Knowledge of C/C++ Programming and basic data structures is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSC/C101.	

Mathematical Foundations of Computer Science- SET/CSE/MT/DSC/C102	
Module	Content
Introduction:	Mathematical notions of sets, sequences and tuples, functions and relations, Primitive recursive functions, computable functions, examples, graphs, strings and languages. Boolean logic – properties and representation, theorems and types of proofs, deductive, inductive, by construction, contradiction and counter-examples.
Number Theory:	Introduction to Number theory, Divisibility, modular arithmetic (addition modulo and multiplication modulo); Statements and applications of Euler and Fermat Theorems, Primitive Roots, Discrete Logarithms, Primarily Test, Finding Large primes, Definition of Elliptic Curves and their applications to Cryptography.
Finite Automata:	Introduction To Finite Automata: Alphabets and languages- Deterministic Finite Automata – Non- deterministic Finite Automata – Equivalence of Deterministic and Non-Finite Automata – Languages Accepted by Finite Automata – Finite Automata and Regular Expressions – Properties of Regular sets & Regular Languages and their applications.
Context Free Languages:	Context Free Languages– Regular Languages and Context Free Grammar – Pushdown Automata – Pushdown Automata and Context-Free Grammar – Properties of Context-Free Languages – pushdown automata and Equivalence with Context Free Grammars.
Turing Machines:	Turing Machines: The Definition of Turing Machine – Computing with Turing Machines – Combining Turing Machines, programming techniques for Turing Machines. Variants of Turing Machines, Restricted Turing Machines Universal Turing Machines. The Halting Problem, Decidable & un-decidable problems- Post Correspondence Problems.
Textbooks:	1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman, Pearson Education Asia.

Practical - SET/CSE/MT/DSC/C102 Mathematical Foundations of Computer Science

Prerequisites: Knowledge of C/C++ Programming and basic data structures is essential. The experiments will be based on the following Paper- **SET/CSE/MT/DSC/C102**.

Advance Computer Organization and Architecture- SET/CSE/MT/DSC/C103	
Module Name	Content
Introduction to Computer Organization and Architecture:	Introduction of Register Transfer and Micro operations, Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit.
Basic Computer Organization and Design:	Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory- Reference Instructions, Input-Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.
Micro programmed Control:	Control Memory, Address Sequencing, Micro program Example, Design of Control Unit. Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC)
Input/output Organization:	Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication. Memory Organization: Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.
Overview of Computer Architecture:	Evolution of Computer Systems, Parallelism in Uniprocessor System, Parallel Computer Structures, Architectural Classification Schemes, Parallel Processing Applications.
Textbooks	1). Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., Third Edition, Sept. 2008. 2) Computer Architecture and Parallel Processing, Kai Hwang and Faye A. Briggs, McGraw Hill, International Edition 1985.
References	1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003. 2. “Computer System Architecture”, John. P. Hayes. 3. Computer Architecture A quantitative approach 3 rd edition John L. Hennessy & David A. Patterson Morgan Kufmann (An Imprint of Elsevier).

Internet of Things-SET/CSE/MT/SEC/C104	
Module Name	Content
M2M to IoT:	The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.
M2M to IoT – A Market Perspective:	Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
M2M and IoT Technology Fundamentals:	Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management
IoT Architecture- State of the Art:	Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model

IoT Reference Architecture-	Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.
Textbooks	☐ 1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014.
Practical -	
SET/CSE/MT/SEC/C104: Internet Of Things	
The experiments will be based on the following Paper- SET/CSE/MT/SEC/C104	

Bioinformatics- SET/CSE/MT/DSE/C105	
Module Name	Content
Module 1	Fundamentals of Biological Systems: Introduction to cells: Structure of prokaryotic and eukaryotic cells. Cell organelles and their functions. Molecules of life: Introduction to carbohydrates, proteins, lipids and nucleic acids – Different structural forms and functional organizations. DNA replication, transcription and translation. Gene regulation.
Module 2	Sequence Analysis: Introduction to Sequence alignment, Substitution matrices, Scoring matrices –PAM and BLOSUM. Local and Global alignment concepts, dot plot, dynamic programming methodology, Multiple sequence alignment- Progressive alignment. Database searches for homologous sequences – FASTA and BLAST versions.
Module 3	Genomics and Proteomics: Functional Genomics: Gene expression analysis by cDNA micro arrays, SAGE, Strategies for generating ESTs and full length inserts; EST clustering and assembly; EST databases- DBEST, UNIGENE Proteomics: Protein and RNA structure prediction, polypeptic composition, secondary and tertiary structure, algorithms for modeling protein folding, structure prediction, proteomics, protein classification, experimental techniques, ligand screening, post-translational modification prediction.
Module 4	Computer Aided Drug Design: Introduction to the concepts of molecular modeling. Molecular structure and internal energy. Macromolecular modeling. Design of ligands for known macromolecular target sites. Drug – receptor interactions. Classical SAR/QSAR studies and their implications to the 3-D modeler. Molecular Docking. Structure-based drug design for all classes of targets.
Textbooks	1. Andreqas D. Baxevanis, B. F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins John Wiley and Sons, New York (1998). 2. C. Rastogi, Namita Mendiratta, Parag Rastogi. Bioinformatics-concepts, skills, Applications 3. Bioinformatics Sequence and Genome Analysis. 2001. David W. Mount. Cold Spring Harbor Laboratory Press.

Practical -
SET/CSE/MT/DSE/C105: Bioinformatics
Prerequisites: Knowledge of biology (especially genetics and molecular biology), computer science (programming and algorithms), and statistics/mathematic Programming is essential. The experiments will be based on the following SET/CSE/MT/DSE/C105 .

Blockchain Technology- SET/CSE/MT/DSE/C106	
Module Name	Content
Introduction to Blockchain:	Definitions of blockchains, The history of blockchain, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Types of blockchain, Benefits and limitations of blockchain.
Decentralization:	Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Platforms for decentralization.
Cryptography and Technical Foundations:	Cryptographic primitives, Asymmetric cryptography, Public and private keys, Hash functions, Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures.
Bitcoin:	Bitcoin definition, Bitcoin Transactions, Bitcoin Blockchain, Bitcoin payments, Bitcoin limitations, Other crypto currency: Namecoin, Litecoin, Zcash.
Ethereum:	Ethereum clients and releases. The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, Elements of the Ethereum blockchain, Precompiled contracts, Mining, Applications developed on Ethereum.
Hyperledger:	Hyperledger as a protocol, Hyperledger Fabric, Sawtooth lake, Corda Architecture, State objects 376 Transactions, Consensus, Flows, Components.
Textbooks	1. Mastering Blockchain – Imran Bashir, Packt Publishing.
References	1 Building Blockchain Projects-Narayan Prusty, Packt Publishing.
Practical - SET/CSE/MT/DSE/C106 Blockchain Technology	
Prerequisites: Knowledge of C/C++ / Python Programming and basic data structures (like hash trees), distributed networking (peer-to-peer systems), and cryptography (hashing, digital signatures) is essential. The experiments will be based on the following SET/CSE/MT/DSE/C106 .	

Natural Language Processing - SET/CSE/MT/DSE/C107	
Module Name	Content
Module 1	Introduction: Knowledge in speech and language processing - Ambiguity - Models and Algorithms - Language, Thought and Understanding. Regular Expressions and automata: Regular expressions - Finite-State automata. Morphology and Finite-State Transducers: Survey of English morphology - Finite-State Morphological parsing - Combining FST lexicon and rules - Lexicon-Free FSTs: The porter stammer - Human morphological processing
Module 2	Syntax: Word classes and part-of-speech tagging: English word classes - Tagsets for English - Part of-speech tagging - Rule-based part-of-speech tagging - Stochastic part- of-speech tagging - Transformation-based tagging - Other issues. Context-Free Grammars for English: Constituency - Context-Free rules and trees - Sentence-level constructions - The noun phrase - Coordination - Agreement - The verb phrase and sub categorization - Auxiliaries - Spoken language syntax - Grammar's equivalence and normal form - Finite-State and Context-Free grammars - Grammars and human processing. Parsing with Context-Free Grammars: Parsing as search - A Basic Top- Down parser -

	Problems with the basic Top-Down parser - The early algorithm - Finite- State parsing methods.
Module 3	Advanced Features and Syntax. Features and Unification: Feature structures - Unification of feature structures - Features structures in the grammar – Implementing unification - Parsing with unification constraints - Types and Inheritance. Lexicalized and Probabilistic Parsing: Probabilistic context-free grammar - problems with PCFGs - Probabilistic lexicalized CFGs - Dependency Grammars - Human parsing.
Module 4	Semantic Representing Meaning: Computational desiderata for representations-Meaning structure of language - First order predicate calculus - Some linguistically relevant concepts - Related representational approaches - Alternative approaches to meaning. Semantic Analysis: Syntax-Driven semantic analysis - Attachments for a fragment of English - Integrating semantic analysis into the early parser - Idioms and compositionality - Robust semantic analysis. Lexical semantics: relational among lexemes and their senses - WordNet: A database of lexical relations - The Internal structure of words - Creativity and the lexicon.
Module 5	Applications Word Sense Disambiguation and Information Retrieval: Selection restriction-based disambiguation - Robust word sense disambiguation - Information retrieval - other information retrieval tasks. Natural Language Generation: Introduction to language generation - Architecture for generation - Surface realization – Discourse planning - Other issues. Machine Translation: Language similarities and differences - The transfer metaphor - The interlingua idea: Using meaning - Direct translation – Using statistical techniques - Usability and system development
Textbooks	1. James A. Natural language Understanding 2e, Pearson Education 2. Bharati A., Sangal R., Chaitanya V. Natural language processing: a Paninian perspective, PHI, 2000. 3. Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP,2008
SET/CSE/MT/DSE/C107: Natural Language Processing	
Prerequisites: Knowledge of python Programming is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSE/C107.	

Research Methodology – SET/CSE/MT/MDE/C108	
Module Name	Content
Introduction:	Objectives of Research, Types of Research, Research Methods and Methodology, Defining Research Problem, Techniques involved in Defining a Problem.
Research Design:	Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample Size Determination, Random sampling.
Measurement & Scaling Techniques:	Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques.
Methods of Data Collection and Analysis:	Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation.
Hypothesis Techniques and Parametric Standard Test:	Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a nonparametric Test, Conversion of Chi to Phi, Caution in using Chi-square test.

Analysis Variance and Co-variance:	ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, Factor Analysis, R-type Q Type factor Analysis, Path Analysis.
Textbooks	1 “Research Methodology”, C.R. Kothari, Wiley Eastern. 2 “Formulation of Hypothesis”, Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.

Semester 2

Advanced Database Management System- SET/CSE/MT/DSC/C201	
Module Name	Content
Introduction to Database Systems:	Database System Applications, Purpose of Database Systems, View of Data – Data Abstraction, Instances and Schemas, Data Models – the ER Model, Relational Model, other Models, Database Languages – DDL, DML, Database Access from Applications Programs, Transaction Management, Data Storage and Querying, Database Architecture, Database Users and Administrators, ER Diagrams, Relational Model: Introduction to the Relational Model – Integrity Constraints Over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design, Introduction to Views, Altering Tables and Views, Relational Algebra, Basic SQL Queries, Nested Queries, Complex Integrity Constraints in SQL, Triggers.
Database Design:	Introduction to Schema Refinement – Problems Caused by redundancy, Decompositions – Problem related to decomposition, Functional Dependencies - Reasoning about FDS, Normal Forms.
Transaction & Security Management:	Transaction Management: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock Based Concurrency Control, Deadlocks, Performance of Locking, Transaction Support in SQL. Concurrency Control: Serializability, and recoverability, Introduction to Lock Management, Lock Conversions, Dealing with Dead Locks, Specialized Locking Techniques, Concurrency Control without Locking. Crash recovery: Introduction to Crash recovery, Introduction to ARIES, the Log, and Other Recovery related Structures, the Write-Ahead Log Protocol, Check pointing, recovering from a System Crash, Media recovery
Distributed Database:	Distributed DBMS features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design - fragmentation, allocation criteria. Distributed deadlocks. Time based and quorum-based protocols. Comparison. Reliability-non-blocking commitment protocols.
Security Issues and Performance measure In Databases:	Security and authorization, authorization in SQL, Encryption and authentication, Security issues in Oracle/DB2 Performance tuning, Performance benchmarks, standardization, performance tuning in Oracle / IBM DB2
Textbooks	1. Database System Concepts, Avi Silberschatz , Henry F. Korth , S. Sudarshan McGraw-Hill, Sixth Edition,
Practical - SET/CSE/MT/DSC/C201: Advance Database Management System	
Prerequisites: Knowledge of SQL programming and basic database management is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSC/C201	

Wireless and Mobile Communication-SET/CSE/MT/DSC/C202	
Module Name	Content
Introduction:	Advantages and disadvantages of wireless networking, Evolution of Mobile Communication generations, Multiple Access Technologies- CDMA, FDMA, TDMA, Frequency reuse, Radio Propagation and Modeling, Challenges in mobile computing: Resource poorness, Bandwidth, energy, etc. Applications of mobile computing, Wireless and Mobile Computing Models, IEEE WLAN Protocols: IEEE 802.11/a/g/n & Bluetooth, Data Management Issues. Sensor Networks- Challenges, Architecture, and Applications.
Cellular Concepts:	Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, improving coverage and capacity in cellular systems, spread spectrum Technologies, Protocols for digital cellular systems such as GSM, EDGE, GPRS, UTMS.
Mobile Architecture:	Mobile Network Layer: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunnelling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP)
Mobile IP:	Problem with Mobility, Terminology, Operation, Tunnelling, Data transfer to the mobile system, Transport Control Protocol (TCP) Over wireless- Indirect TCP (I-TCP), Snoop TCP, Mobile TCP (M-TCP), Case Study of Client/Server architecture.
Mobile Ad-Hoc Networks:	Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs. Routing protocols Destination sequenced distance vector algorithm, Cluster based gateway switch routing, ad hoc on-demand routing, Fisheye routing protocol CBRP, Zonal routing algorithm.
Textbooks	1. Charles E. Perkins, Ad hoc Networks, Addison Wesley, 2008. 2. Schiller J., Mobile Communications, Addison Wesley (2000). 3. Stallings W., Wireless Communications and Networks, Pearson Education

Cryptography and Network Security-SET/CSE/MT/DSC/C203	
Module Name	Content
Introduction:	OSI Security Architecture - Classical Encryption techniques - Cipher Principles - Data Encryption Standard - Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES - AES Cipher - Triple DES - Placement of Encryption Function - Traffic Confidentiality
Public Key Cryptography:	Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption - Public Key Cryptography and RSA.
Authentication and Hash Function:	Authentication requirements - Authentication functions - Message Authentication Codes - Hash Functions - Security of Hash Functions and MACs - MD5 message Digest algorithm - Secure Hash Algorithm - RIPEMD - HMAC Digital Signatures - Authentication Protocols - Digital Signature Standard.
Network Security:	Authentication Applications: Kerberos - X.509 Authentication Service - Electronic Mail Security - PGP - S/MIME - IP Security - Web Security. SYSTEM LEVEL SECURITY: Intrusion detection - password management - Viruses and related Threats - Virus Counter measures - Firewall Design Principles - Trusted Systems.

Security Metrics:	Legal, Privacy and Ethical issues in digital security. Program and data Protection by patents, copyrights and trademarks, information and the law, computer crime, privacy, Ethical issues in digital security and codes of professional ethics.
Textbooks	1. Cryptography and network security- principles and practice – William Stallings (3rd Edition, Person Prentice Hall) . 2. Network Security private communication in a practice – Charles Kaufman, Radio Perlman, Mike spicier (2nd Edition Pearson Print ice Hall) 3. Cryptography and network security – Atul Kahate (TMGH)

Advanced Compiler Design- SET/CSE/MT/SEC/C204	
Module Name	Content
Introduction to Compiler Design:	Compiler & Translators, Structure of compiler, Lexical Analyzer, Syntax analyzer, Intermediate code generator. Optimization, code generation, Error handling, compiler writing tools, structures of high-level language, The Syntactic specification of programming Languages.
Lexical Analysis:	Lexical Analyzer, approaches to design of Lexical Analyzer, regular expression, finite automata, language for specifying Lexical Analyzer, Implementation of a Lexical Analyzer.
Parsing Technique:	Parsers, Shift reduce parsing, operator – precedence parsing, Top-Down parsing, predicative parsing. Technique2: LR parsers Construction of SLR Parser, Construction of CLR Parser, Construction of LALR Parser.
Syntax Directed Translation:	Syntax- directed translator schemes and implementation, intermediate code, postfix notation, three address coding, quadruple & triple, translation of assignment statements, Boolean expression, Conditional statements, Postfix translations, array reference, Procedure calls, case statements, record structures.
Code Optimization and Generation:	Sources of Optimization, Loop Optimization, DAG representation, Global Data Flow Analysis. Code Generation: Problems in code generation. Simple code generator, code generator from DAG's, Peephole optimization, Brief description of Symbol tables, Error detection and recovery, Runtime storage administration.
Parallel Compilers & Compilation for Distributed Machines:	Motivation and overview, Structure of a Parallelizing compiler. Parallelism detection: data dependence, direction vectors, loop carried and loop independent dependences. Data partitioning, instruction scheduling, register allocation, machine optimization. Dynamic compilation. Just in time (JIT) compilers, Auto scheduling compilers.
Textbooks	1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D.Ullman, Pearson. 2.Principles of compiler design by Alfred V.Aho, D. Ullman
Practical - SET/CSE/MT/SEC/C204: Advanced Compiler Design	
The experiments will be based on the following Paper- SET/CSE/MT/SEC/C204.	

Pattern Recognition- SET/CSE/MT/DSE/C205	
Module Name	Content
Module 1	Pattern Classifier: Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayesian parameter estimation- Perceptron algorithm - LMSE algorithm - Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.

Module 2	Unsupervised Classification: Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm – Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.
Module 3	Structural Pattern Recognition Elements of formal grammars - String generation as pattern description - Recognition of syntactic description - Parsing -Stochastic grammars and applications - Graph based structural representation.
Module 4	Feature Extraction and Selection: Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation - Binary feature selection.
Module 5	Recent advances: Neural network structures for Pattern Recognition - Neural network-based Pattern associators – Unsupervised learning in neural Pattern Recognition - Self organizing networks - Fuzzy logic - Fuzzy pattern classifiers - Pattern classification using Genetic Algorithms.
Textbooks	1. Robert J. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 1992. 2. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974. 3. Duda R.O., and Hart. P. E., Pattern Classification and Scene Analysis, Wiley, New York, 1973. 4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
Practical - SET/CSE/MT/DSE/C205: Pattern Recognition	
The experiments will be based on the following: Paper- SET/CSE/MT/DSE/C205.	

Cloud Computing SET/CSE/MT/DSE/C206	
Module Name	Content
Introduction to Cloud Computing:	Evolution of Cloud Computing –System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture -IaaS – On-demand Provisioning – Elasticity in Cloud – E.g. Of IaaS Providers - PaaS – E.g. of PaaS Providers - SaaS – E.g. of SaaS Providers – Public, Private and Hybrid Clouds.
Virtualization Technology:	Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor, VMware, KVM, Xen. Virtualization of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, SLA & Power consumption management, Virtualization of Server.VM Migration.
Networking Support for Cloud Computing:	Ubiquitous Cloud and the Internet of Things. Cloud Computing Architecture: Cloud Reference Model, Layer and Types of Clouds, Services models, Data centre Design and interconnection Network, Architectural design of Computer and Storage Clouds.
Cloud Applications:	Web-Based Application, Pros and Cons of Cloud Service Development, Types of Cloud Service Development, Software as a Service, Platform as a Service, Web Services, OnDemand Computing, Discovering Cloud Services, Development Services and Tools, Amazon Ec2, Google App Engine, IBM Clouds
Security in the Cloud:	Security Overview – Cloud Security Challenges – Software-as-a-Service Security– Security Governance – Risk Management – Security Monitoring –Security Architecture Design – Data Security – Application Security – Virtual Machine Security
Case Study	Case Study and analysis of cloud computing environment using cloud simulator toolkit.

Textbooks	1. Raj Kumar Buyya, “Cloud Computing: Principles and Paradigms, wiley 2. Barrie Sosinsky, “Cloud Computing Bible”, Wiley Publishers 3. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation
Practical - SET/CSE/MT/DSE/C206: Cloud Computing	
Prerequisites: Knowledge of Java/ Python Programming and basic data structures and computer networking is essential. The experiments will be based on the following subject SET/CSE/MT/DSE/C206	

Soft Computing- SET/CSE/MT/DSE/C207	
Module Name	Content
Module 1	Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics
Module 2	Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.
Module 3	NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks
Module 4	GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition. Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm.
Textbooks	Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro: Fuzzyand Soft Computing, Prentice:Hall of India, 2003. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications Prentice Hall, 1995.
Practical - SET/CSE/MT/DSE/C207: Soft Computing	
Prerequisites: Knowledge of Python or MATLAB Programming. The experiments will be based on the following Paper- SET/CSE/MT/DSE/C207	

Quantum Computation- SET/CSE/MT/MDE/C208	
Module	Content
Introduction to Quantum Computation:	Quantum bits, Bloch sphere representation of a qubit, multiple qubits. Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.
Quantum Circuits:	Single qubit gates, multiple qubit gates, design of quantum circuits.
Quantum Information and Cryptography:	Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.
Quantum Algorithms:	Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch’s algorithm, Deutsch’s-Jozsa algorithm, Shor factorization, Grover search.
Noise and error correction:	Graph states and codes, Quantum error correction, fault-tolerant computation.

Textbooks	Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
Practical - SET/CSE/MT/MDE/C208: Quantum Computation	
Prerequisites: Knowledge of python Programming and a strong foundation in linear algebra (vectors, matrices, eigenvalues), complex numbers, and probability theory is essential. The experiments will be based on the following subject- SET/CSE/MT/MDE/C208	

Semester 3

Advance Operating Systems- SET/CSE/MT/DSC/C301	
Module Name	Content
Introduction To Operating Systems:	Types Of Operating Systems, Operating System Structures. Operating-System Services, System Calls, Virtual Machines, Operating System Design and Implementation. Process Management: Process Concepts, Operations On Processes, Cooperating Processes, Threads, Inter Process Communication, Process Scheduling, Scheduling Algorithms, Multiple-Processor Scheduling. Thread Scheduling.
Process Synchronization & Deadlocks:	The Critical Section Problem, Semaphores, And Classical Problems Of Synchronization, Critical Regions, Monitors, Deadlocks,-System Model, Deadlocks Characterization, Methods For Handling Deadlocks, Deadlock-Prevention, Avoidance, Detection and Recovery from Deadlocks.
Memory Management & File System Implementation:	Logical Versus Physical Address Space, Paging And Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing, File System Implementation -Access Methods, Directory Structure, Protection, File System Structure, Allocation Methods, Free Space Management, Directory Management, Device Drivers.
Distributed Operating Systems:	Distributed System Goals, Types Of Distributed Systems, Styles & Architecture Of Distributed Systems, Threads, Virtualization, Clients, Servers, Code Migration, and Communication in Distributed Systems. Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning Of Nodes, Data-Centric Consistency Models, Client-Centric Consistency Models, Consistency Protocols.
Fault Tolerance & Security:	Introduction To Fault Tolerance, Process Resilience, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, Recovery, Secure Channels, Access Control, Security Management.
Case Study:	Overview Of UNIX, LINUX Operating systems
Textbooks:	Silberschatz & Galvin, ‘Operating System Concepts’, Wiley. “DISTRIBUTED SYSTEMS”, Second edition, Andrew S. Tanenbaum, Maarten Van teen.
Practical - SET/CSE/MT/DSC/C301: Advance Operating Systems	
Prerequisites: Knowledge of C/C++ Programming and basic operating system is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSC/C301.	

SET/CSE/MT/DSC/302: Seminar

A student is required to present seminar on course related topic. Three copies of bound report of the seminar should be submitted one week before the presentation to office of Head/Concerned faculty (examiner) appointed by the Head.

SET/CSE/MT/DSC/C303: Dissertation Phase-I

The student will submit a synopsis at the beginning of the semester for approval to Dissertation evaluation committee in a specified format. The student will have to present the progress of the work through seminars presentation and progress report. A report must be submitted to the committee for evaluation purpose at the end of the semester in a specified format.

Modeling and Simulation- SET/CSE/MT/DSC/C304	
Module Name	Content
Introduction:	System – ways to analyze the system – Model – types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypotheses- steps – types 1 & 2 errors – Framing – strong law of large numbers
Building of Simulation model:	Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.
Generation of random variants:	Generation of random variants – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poisson. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT – Simulation of M/M/1 queue – comparison of simulation languages.
Output data analysis:	Output data analysis – Types of Simulation w.r.t output dat analysis – warmup period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons.
Applications of Simulation:	Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Ne wboy paper problem.
Textbooks	Simulation Modelling and Analysis / Law, A.M. & Kelton / McGraw Hill, 2nd Edition, New York, 1991. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990.
Practical - SET/CSE/MT/DSE/C302: Modeling and Simulation	
Prerequisites: Knowledge of python Programming is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSEC304.	

Computer Network Administrator - SET/CSE/MT/DSE/C305	
Module Name	Content
Module 1	Data Communication and network management overview: Analogy of telephone network management, Data and telecommunication network, distributed computing environment, TCP/IP based networks– Internet and intranet, communication protocols and standards, challenges of information technology manager Network management –goals, organization and functions, network and system management, network management system platform, current status and future of network management.
Module 2	Basic foundation: Standards, models and languages: Network management standards, network management model, organization model, information model, communication model, ASN.1, Encoding structure, macros, and functional model.
Module 3	SNMP 1 network management: Organization and information models: Managed network, international organization and standard SNMP model, organization model, system overview, information models
Module 4	SNMP v1 network management: Communication and functional models, SNMP model, functional model, Major changes in SNMP v2 and v3 SNMP Management: RMON –Remote monitoring, RMON, SMI & MIB, RMON1, RMOPN2, ATM Remote monitoring, case study of internet traffic using RMON.
Module 5	Network management tools and systems: network management tools, network statistics measurement systems, network management systems, commercial network management systems, System management, Enterprise management solutions.
Textbooks	1.Network Management principles and practice Mani Subramanian (Pearson Edition) 2. SNMP – SNMPv2, SNMPv3 & RMON 1 – William Stalling (Pearson Edition) 3. Network Administration – Steve Wisniewski

Practical - SET/CSE/MT/DSE/C305: Computer Network Administrator
Prerequisites: Knowledge of C/C++/Python Programming and basic computer networks is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSE/C305 .

Grid Computing - SET/CSE/MT/DSE/C306	
Module Name	Content
Module 1	Grid Computing: Introduction - Definition - Scope of grid computing.
Module 2	Grid Computing Initiatives: Grid Computing Organizations and their roles – Grid Computing analog – Grid Computing road map.
Module 3	Grid Computing Applications: Merging the Grid sources – Architecture with the Web Devices Architecture.
Module 4	Technologies: OGSA – Sample use cases – OGSA platform components OGSI – OGSA Basic Services.

Module 5	Grid Computing Tool Kits Globus Toolkit – Architecture, Programming model, High level services – OGSI .Net middleware Solutions.
Textbooks	1.Joshy Joseph & Craig Fellenstein, “Grid Computing”, PHI, PTR-2003. 2.Ahmar Abbas, “Grid Computing: A Practical Guide to technology and Applications”, Charles River media – 2003.
Practical - SET/CSE/MT/DSE/C306: Grid Computing	
Prerequisites: Knowledge of computer network and python programming is essential. The experiments will be based on the following Paper- SET/CSE/MT/DSE/C306 .	

Genetic Algorithms and Applications- SET/CSE/MT/MDE/C307	
Module Name	Content
Module 1	Fundamentals of genetic algorithm: A brief history of evolutionary computation- biological terminology-search space -encoding, reproduction- elements of genetic algorithm-genetic modeling-comparison of GA and traditional search methods.
Module 2	Genetic Technology: steady state algorithm - fitness scaling - inversion. Genetic programming - Genetic Algorithm in problem solving
Module 3	Genetic Algorithm in engineering and optimization-natural evolution– simulated annealing and Tabu search. Genetic Algorithm in scientific models and theoretical foundations.
Module 4	Implementing a Genetic Algorithm – computer implementation - low level operator and knowledge-based techniques in Genetic Algorithm.
Module 5	Applications of Genetic based machine learning-Genetic Algorithm and parallel processors, composite laminates, constraint optimization, multilevel optimization, real life problem.
Textbooks	1. Melanie Mitchell, An introduction to Genetic Algorithm, Prentice-Hall of India, New Delhi, Edition: 2004 2. David. E. Golberg, 'Genetic algorithms in search, optimization and machine learning', Addition-Wesley-1999 3. S. Rajasekaran G.A Vijayalakshmi Pai, “Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis and Applications”, Prentice Hall of India, New Delhi-2003. 4. Nils. J. Nilsson, “Artificial Intelligence- A new synthesis”, Original edition- 1999.

Practical - SET/CSE/MT/MDE/C307: Genetic Algorithms and Applications
Prerequisites: Knowledge of python programming and basic genetic algorithm methods are essential. The experiments will be based on the following Paper- SET/CSE/MT/MDE/C307 .

Semester 4

SET/CSE/MT/DSC/C401: Dissertation Phase (II)
A student is required to submit three copies of bound report of the dissertation after pre-submission presentation to office of Head duly signed by his/her supervisor signed by his/her supervisor. Publication of thesis related work must be published in some reputed peer reviewed journals (or UGC listed) or Scopus indexed conferences. Thesis will be graded as follows:

S. No.	Grade	Condition
1	O	Two Publications from thesis in SCI indexed Journal.
2	A+	One Publication from thesis in SCI indexed Journal.
3	A	Publication from thesis in Scopus indexed Journal.
4	B+	Publication from thesis in Proceeding of conference which is Scopus indexed.
5	B	Presented paper in International Conference.
6	C/C+	Presented paper in National Conference.

The final year project/ thesis work shall be carried out during the 3rd and 4th semester. Final year project work would be evaluated in the end of 3rd and 4th semester. Students can undertake final year project individually under the guidance of a faculty or a group of faculties.