Curriculum and Syllabus

M. Tech

Computer Science and Engineering

(Applicable for 2018-19 batch and onwards)

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

Curriculum

SEMESTER 1		
CODE NO.	**COURSE**	**CREDITS**
SET/CSE/MT/C101	Mathematical Foundation of Computer Science	3
SET/CSE/MT/C102	Advance Data Structures & Algorithms	3
SET/CSE/MT/C103	Advance Operating systems	3
SET/CSE/MT/C104	Advance Computer Organization and Architecture	3
SET/CSE/MT/C105	Advance Database Management System	3
SET/CSE/MT/CP11	*Lab-1 (Based on C102 and C105)*	3
Total		**18**
SEMESTER 2		
CODE NO.	**COURSE**	**CREDITS**
SET/CSE/MT/C201	Compiler Design	3
SET/CSE/MT/C202	Wireless and Mobile Communication	3
SET/CSE/MT/C203	Cryptography and Network Security	3
SET/CSE/MT/C203	Digital Image Processing	3
SET/CSE/MT/C203	Cloud Computing	3
SET/CSE/MT/CP21	*Lab -2 (Based on C202 and C203))*	3
Total		**18**
SET/CSE/MT/SS1	Self-Study Course (from elective courses)	3
SEMESTER 3		
CODE NO.	**COURSE**	**CREDITS**
	Elective 3	3
	Elective 4	3
SET/CSE/MT/S31	Seminar	2
SET/CSE MT/T301	Thesis work preliminary	10
Total		**18**
SET/CSE/MT/SS2	Self-Study Course (from elective courses)	3
SEMESTER 4		
CODE NO.	**COURSE**	**CREDITS**
SET/CSE/MT/T401	Thesis/Dissertation	18
Total		**18**
Grand Total		**72**

NOTE :

(1) One hour of lecture/tutorial has a credit equivalence of 1. Three hours of lab is equivalent to one hour of lecture.

(2) Students shall choose minimum two elective subjects in the third semester, from the following Table -1.

(3) Students may also choose additional Electives, however the Overall CGPA of M. Tech. degree would be calculated based on the best 72 credits excluding self-study courses.

(4) Student shall qualify oneself study courses from elective courses, in the 2^{nd} or 3^{rd} semesters. Grades obtained in self-study course will not be used for calculation of overall GPA / CGPA.

(5) Student will be assigned a final year project/thesis guide (s) in the beginning of second semester.

(6) 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 semester and 4th semester. Student can undertake final year project individually under the guidance of a faculty or a group of faculty.

Table 1 – List of Electives		
S. No.	**Code**	**Subject Name**
1.	SET/CSE/MT/E 301	Data Warehousing and Data Mining
2.	SET/CSE/MT/E 302	Multicore Architecture
3.	SET/CSE/MT/E 303	Advanced Network Programming
4.	SET/CSE/MT/E 304	Embedded systems
5.	SET/CSE/MT/E 305	Parallel Computation and Applications
6.	SET/CSE/MT/E 306	Research Methodology
7.	SET/CSE/MT/E 307	High Performance Networks.
8.	SET/CSE/MT/E 308	Natural Language Processing
9.	SET/CSE/MT/E 309	Grid Computing
10.	SET/CSE/MT/E 310	Object Oriented Software Engineering.
11.	SET/CSE/MT/E 311	Computer Network Administration
12.	SET/CSE/MT/E 312	Bioinformatics
13.	SET/CSE/MT/E 313	Pattern Recognition
14.	SET/CSE/MT/E 314	Genetic Algorithms and Applications
15.	SET/CSE/MT/E 315	Modeling and Simulation
16.	SET/CSE/MT/E 316	Intrusion Detection
17.	SET/CSE/MT/E 317	Soft computing
18.	SET/CSE/MT/E 318	Blockchain Technology
19.	SET/CSE/MT/E 319	Internet of Things
20.	SET/CSE/MT/E 320	Quantum Computation

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.

First Semester

Mathematical Foundations of Computer Science- SET/CSE/MT/C101	
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: Context –Free Grammar – 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.
References:	1. Introduction to languages and theory of computation – John C. Martin (MGH) 2. Discrete Mathematical structures with application to Computer Science – J.P. Tremblay and R. Manohar 3. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole) 4. Cryptanalysis of number theoretic Cyphers, Samuel S. Wagstaff Jr.Champan & Hall/CRC Press 2003. 5. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes –Ousley, Keith Strassberg TataMcGraw-Hill.

Advance Data Structures and Algorithm- SET/CSE/MT/C102	
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: **Trees:**	Abstract Data Types, Representation & implementation of ADT list, doubly linked list, Circular linked lists, Representation, Implementation and applications of ADT stack and Queue. Implementation and 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.
Sorting Algorithms:	Sorting like insertion Sort, shell Sort, Heap Sort, Merge Sort, Quick Sort and Simple external sorting algorithm.
Greedy method and Dynamic Programming	General methods, Job sequencing with deadlines, Minimum spanning trees, Optimal merge patterns, knapsack Problem, All pair's shortest paths, Optimal binary search trees, Reliability design, Traveling salesman problem and flow shop scheduling.
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:	1. Data Structures & Algorithm Analysis in C++ , Mark Allen Weiss. Second edition, Pearson Edition. Asia.
References:	1. Data Structures & Algorithm in C++, Adam Drozdek. Vikas Publication House. 2. Data Structure, Algorithm and OOP, Gregory L. Heileman (Tata Mc Graw Hill Edition). 3. Data Structures, Algorithms and Applications in C++,Sartaj Sahni,Mc Graw-Hill International Edition.

Advance Operating Systems- SET/CSE/MT/C103	
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:	1) Silberschatz & Galvin, 'Operating System Concepts', Wiley. 2) "DISTRIBUTED SYSTEMS", Second edition, Andrew S.Tanenbaum, Maarten Van teen.
References	1) William Stallings-"Operating Systems"- 5th Edition - PHI 2) Charles Crowley, 'Operating Systems: A Design-Oriented Approach', Tata Hill Co., 1998 edition. 3) Andrew S.Tanenbaum, 'Modern Operating Systems', 2nd edition, 1995, PHI. 4) Advanced Concepts in Operating systems.Distributed, Database and Multiprocessor operating systems, Mukesh singhal, Niranjan G.Shivaratri, Tata McGraw Hill Edition.

Advance Computer Organization and Architecture- SET/CSE/MT/C104	
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. Flynn's classifications – SISD, SIMD, MISD, MIMD, Examples from Vector & Array Processors, Performance comparison of algorithms for Scalar, Vector and Array Processors, Fundamentals of UMA, NUMA, NORMA architectures
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 Edition1985.
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 3rd edition John L. Hennessy & David A. Patterson Morgan Kufmann

Advance Database Management System- SET/CSE/MT/C105	
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, SixthEdition,
References	1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke,McGraw-Hill.

Practical - SET/CSE/MT/CP11
CP102: Data Structures & Algorithms
Prerequisites: Knowledge of C/C++ Programming and basic data structures is essential. The experiments will be based on the following Paper- C102
C105: Advance Database Management System
Prerequisites: Knowledge of C/C++ Programming is essential. The experiments will be based on the following paper: C105- Advance Database Management System.

Second Semester

Compiler Design- SET/CSE/MT/C201	
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 Constanction of SLR Parser, Constanction of CLR Parser, Constanction 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 Parallelzing 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
References	1. Compiler Design, Trembly and Sorauson, Tata Mcgraw Hill. 2. Systems programming by John. J. Donovan (chapter 8) 3. Theory of Computer science by K.L.P. Mishra & N.Chandra Sekhran (chapter 2,3,4) 4. Compiler Design in C – Allen I. Holub, PHI.

Wireless and Mobile Communication-SET/CSE/MT/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, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP)
Mobile IP:	Problem with Mobility, Terminology, Operation, Tunneling, 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/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 (3 rd Edition, Person Prentice Hall) . 2. Network Security private communication in a practice – char tic Kaufman, Radio Perl man, Mike spicier (2 nd Edition Pearson Print ice Hall) 3. Cryptography and network security – Atul Kahate (TMGH)

Digital Image Processing- SET/CSE/MT/C204 L T P 3 1 0	
Module Name	**Content**
Introduction to Image Processing:	Introduction – Elements of visual perception, Steps in Image Processing Systems, image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models, File Formats. Introduction to the Mathematical tools.
Image Enhancement and Restoration:	Spatial Domain Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – DFT, FFT, DCT, Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.
Image Segmentation and Feature Analysis:	3D-Detection of Discontinuities – Edge Operators– Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Feature Analysis and Extraction.
Multi Resolution Analysis and Compressions :	Image Pyramids – Multi resolution expansion – Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets. Image Compression: Fundamentals – Models – Elements of Information Theory – Error Free Compression – Lossy Compression – Compression Standards – JPEG/MPEG.
Applications of Image Processing:	Representation and Description, Image Recognition- Image Understanding – Image Classification – Video Motion Analysis – Image Fusion – Steganography – Colour Image Processing.
Textbooks	1. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Third Edition, Pearson Education, 2008. 2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Third Edition, Brooks Cole, 2008. 3. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice-Hall India, 2007. 4. Madhuri A. Joshi, 'Digital Image Processing: An Algorithmic Approach", Prentice- Hall India, 2006. 5. Rafael C.Gonzalez , Richard E.Woods and Steven L. Eddins, "Digital Image Processing Using MATLAB", First Edition, Pearson Education, 2004.

Cloud Computing.- SET/CSE/MT/C205 L T P 3 1 0	
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 center 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, On-Demand 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

List of Electives Subjects

Data Warehousing and Data Mining - SET/CSE/MT/E301 L T P 3 1 0	
Module Name	**Content**
Module 1	Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture –DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.
Module 2	Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.
Module 3	Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section
Module 4	Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High- Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.
Module 5	Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining Multimedia Data Mining – Text Mining – Mining the World Wide Web.
Textbooks	1.Jiawei Han and Micheline Kamber "Data Mining Concepts and Techniques" Second Edition, Elsevier, Reprinted 2008. 2. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007. 3.K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

Multicore Architecture - SET/CSE/MT/E 302 L T P 3 1 0	
Module Name	**Content**
Module 1	Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization..
Module 2	Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives.
Module 3	Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, and Flow Control- based Concepts, Fence, Barrier and Implementation-dependent Threading Features. Threading APIs : Threading APls for Microsoft Windows, Win32/MFC Thread APls, Threading APls for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.
Module 4	OpenMP: A Portable Solution for Threading: Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance.
Module 5	Solutions to Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance.
Textbooks	1.Hennessey & Pateterson, "Computer Architecture A Quantitative Approach", Harcourt Asia, Morgan Kaufmann, 1999. 2. Joseph JaJa, Introduction to Parallel Algorithms, Addison-Wesley, 1992. IBM Journals for Power 5, Power 6 and Cell Broadband engine architecture. 3. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006

Advanced Network Programming - SET/CSE/MT/C303 L T P 3 1 0	
Module Name	**Content**
Module 1	Java Fundamentals: Java I/O streaming - filter and pipe streams - Byte Code interpretation - reflection - Dynamic Reflexive Classes - Threading - Java Native interfaces- Swing.
Module 2	Network Programming in Java: Sockets - secure sockets - custom sockets – UDP datagrams - multicast sockets - URL classes - Reading Data from the server – writing data - configuring the connection - Reading the header - telnet application - Java Messaging services.
Module 3	Applications in Distributed Environment: Remote method Invocation - activation models - RMI custom sockets - Object Serialization - RMI - IIOP implementation - CORBA - IDL technology - Naming Services - CORBA programming Models - JAR file creation.
Module 4	Multi-tier Application Development: Server side programming - servlets - Java Server Pages - Applet to Applet communication - applet to Servlet communication - JDBC - Using BLOB and CLOB objects - storing Multimedia data into databases – Multimedia streaming applications - Java Media Framework.
Module 5	Enterprise Applications: Server Side Component Architecture - Introduction to J2EE - Session Beans - Entity Beans - Persistent Entity Beans – Transactions.
Textbooks	1. Elliotte Rusty Harold, " Java Network Programming", O'Reilly publishers, 3rd Edition, 2004 2. Hortsmann & Cornell, "CORE JAVA 2 ADVANCED FEATURES, VOL II", Pearson Education, 2002. (UNIT I and UNIT IV) 3. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", Tata McGraw-Hill, 2003

Embedded Systems- SET/CSE/MT/E 304 L T P 3 1 0	
Module Name	**Content**
Module 1	Introduction to Embedded Systems: Definition and Classification – Overview of Processors and hardware units in an embedded system – Software embedded into the system – Exemplary Embedded Systems – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits
Module 2	Devices and Buses for Devices Network: I/O Devices - Device I/O Types and Examples – Synchronous - Iso-synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices - UART and HDLC - Parallel Port Devices - Sophisticated interfacing features in Devices/Ports- Timer and Counting Devices - '12C', 'USB', 'CAN' and advanced I/O Serial high speed buses- ISA, PCI, PCI-X, cPCI and advanced buses.
Module 3	Embedded Programming: Programming in assembly language (ALP) vs. High Level Language - C Program Elements, Macros and functions -Use of Pointers - NULL Pointers - Use of Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers – Concepts of EMBEDDED PROGRAMMING in C++ - Objected Oriented Programming – Embedded Programming in C++, 'C' Program compilers – Cross compiler – Optimization of memory codes.
Module 4	Real Time Operating Systems – Part – 1 OS Services – Interrupt Routines Handling, Task scheduling models - Handling of task scheduling and latency and deadlines as performance metrics - Inter Process Communication And Synchronisation – Shared data problem – Use of Semaphore(s) – Priority Inversion Problem and Deadlock Situations – Inter Process Communications using Signals – Semaphore Flag or mutex as Resource key – Message Queues – Mailboxes – Pipes – Virtual (Logical) Sockets – RPCs.
Module 5	Real Time Operating Systems – Part – 2 Study of RTOS, VxWorks - Basic Features - Task Management Library at the System - Library Header File - VxWorks System Functions and System Tasks - Inter Process (Task) Communication Functions - Case Study of Coding for Sending Application Layer Byte Streams on a TCP/IP Network Using RTOS Vxworks
Textbooks	1 Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw Hill, First reprint 2003 2. David E.Simon, An Embedded Software Primer, Pearson Education Asia, FirstIndian Reprint 2000.

Parallel Computation and Applications- SET/CSE/MT/E 305 L T P 3 1 0	
Module Name	**Content**
Module 1	Introduction to Parallel Processing. - Criteria for judging the architecture, Architectural classification schemes, Trends towards parallel processing, Parallelism in uni processor systems, Parallel Computer Structure, Applications of parallel processing Principles of Pipelining - Principles of Linear and non-linear pipelining, classification of pipeline processors, general pipelines and reservation tables, Interleaved memory organization .
Module 2	Structures and algorithms for Array Processors - SIMD array processors: SIMD Computer organization, Masking and data routing mechanisms, SIMD interconnection networks: static v/s dynamic, mesh connected ILLIAC network, Barrel Shifter network, Shffle-exchange and omega network.
Module 3	Multiprocessor Architecture - Functional structures, UMA and NUMA multiprocessors. Interconnection Networks: Time shared or common buses, Bus arbitration algorithm, Cross bar switch and multiport memories, Comparison of multiprocessor interconnection structure, multistage networks for multiprocessors. Algorithm Analysis - Mathematical background, What to analyze, Running time calculation, Logarithms in Running time
Module 4	Algorithm design techniques - Greedy algorithms, Simple Scheduling algorithms, Multiprocessor case, Huffman code analysis, Bin packing algorithms, Back tracking algorithms, Turnpike reconstruction algorithm Parallel processing terminology - Speed up, scaled speed up and parallelizability
Module 5	Elementary parallel algorithms - Hypercube SIMD model, Shuffle-exchange SIMD model, 2-D mesh SIMD, UMA multiprocessor, Broadcast Matrix multiplication - Algorithms for Processor arrays, Algorithms for multiprocessors and multicomputers. Sorting - Lower bounds on parallel sorting, Odd-Even transposition sort
Textbooks	1. Kai hwang and Faye A. Briggs, Computer Architecture and Parallel Processing McGraw Hill Series. 2. Kaihwang, Advanced Computer Architecture – Parallelism, Scalability, Programmability. 3. Michael J. Quinn, Parallel Computing – Theory and Practice – McGraw Hill Publication. 4. Mark Allen Weiss- Data Structures and Algorithm Analysis in C – Benjamin/Cummings Publication.

Research Methodology - SET/CSE/MT/E 306

L T P
3 1 0

Module Name	Content
Introduction	Objectives of Research, Types of Research, Research Methods and Methodology, Defining aResearch 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, 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 non-parametric 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. 3. "Research in Education", John W Best and V. Kahn, PHI Publication. 4. "Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson Education 5. "Management Research Methodology-Integration of principles, methods and Techniques", K.N.Krishnaswami and others, Pearson Education.

High Performance Networks - SET/CSE/MT/E 307 L T P 3 1 0	
Module Name	**Content**
Module 1	Basics of Networks: telephone, Cable television and Wireless network, networking principles, Digitalization: Service integration, network services and layered architecture, traffic characterization and QOS, networks services: network elements and network mechanisms.
Module 2	Packet switched networks: OSI and IP models: Ethernet (IEEE 802.3); Token Ring (IEEE 802.5),FDDI, DQDB, frame relay, SMDS Internet working with SMDS.
Module 3	Internet and TCP/IP networks: Overview internet protocol; TCP and VDP; performance of TCP/IP networks circuit switched networks: SONET; DWDM, Fiber to home, DSL. Intelligent networks, CATV.
Module 4	ATM and wireless networks: Main features- addressing, signaling and routing; ATM header structure-adaptation layer, management and control; BISDN; Interworking with ATM ,Wireless channel, link level design, channel access; Network design and wireless networks
Module 5	Optical networks and switching: Optical links- WDM systems, cross-connects ,optical LAN's, optical paths and networks; TDS and SDS: modular switch designs-Packets switching, distributed, shared, input and output buffers.
Textbooks	1. Jean warland and Pravin Varaiya,High,Performance Communication Networks,2nd Edition,Harcourt and Morgan Kauffman,London,2000 2. Leon Gracia,Widjaja,Communication Networks,Tata McGraw Hill,New Delhi,2000 3. Sumit Kasera,Pankaj Sethi,ATM Networks,Tata McGraw Hill,New Delhi,2000 4. Behrouz. Forouzan,Data Communication and Networking,Tata McGraw Hill,New Delhi,2000 .

Natural Language Processing - SET/CSE/MT/E 308 L T P 3 1 0	
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 phase and sub categorization - Auxiliaries - Spoken language syntax - Grammars 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

Grid Computing - SET/CSE/MT/E 309 L T P 3 1 0	
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.

Object Oriented Software Engineering- SET/CSE/MT/E 310 L T P 3 1 0	
Module Name	**Content**
Module 1	System Concepts – Project Organization – Communication – Project Management.
Module 2	Life cycle models – Unified Process – Iterative and Incremental – Workflow – Agile Processes.
Module 3	Requirements Elicitation – Use Cases – Unified Modeling Language, Tools – Analysis Object Model (Domain Model) – Analysis Dynamic Models – Non-functional requirements – Analysis Patterns.
Module 4	System Design, Architecture – Design Principles - Design Patterns – Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language.
Module 5	Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance
Textbooks	1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd Ed, Pearson Education, 2004. 2. Craig Larman, Applying UML and Patterns 3rd ed, Pearson Education, 2005. 3. Stephen Schach, Software Engineering 7th Ed, McGraw-Hill, 2007. 4. Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Software Development Process, Pearson Education, 1999. 5. Alistair Cockburn, Agile Software Development 2nd ed, Pearson Education, 2007.

Computer Network Administrator - SET/CSE/MT/E 311 L T P 3 1 0	
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

Bioinformatics- SET/CSE/MT/E 312 L T P 3 1 0	
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. 4. Andrew,R. Leach Molecular modeling: Principles and applications Prentice Hall Publications.

Pattern Recognition- SET/CSE/MT/E 313

L T P
3 1 0

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.

Genetic Algorithms and Applications- SET/CSE/MT/E 314 L T P 3 1 0	
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.

Modeling and Simulation- SET/CSE/MT/E 315	L T P 3 1 0
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 hypothesis-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 – Newboy paper problem.
Textbooks	1. Simulation Modelling and Analysis / Law, A.M. & Kelton / McGraw Hill, 2nd Edition, New York, 1991. 2. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990.
References	1 Building Blockchain Projects-Narayan Prusty, Packt Publishing.

Intrusion Detection - SET/CSE/MT/E 316

L T P
3 1 0

Module Name	Content
Module 1	The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's - Overview of Intrusion Detection and Intrusion Prevention Network and Host-based IDS
Module 2	Classes of attacks - Network layer: scans, denial of service, penetration-Application layer: software exploits, code injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/sop Hesitated groups-Automated: Drones, Worms, Viruses
Module 3	A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS. Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)-Host-based Anomaly Detectors-Software Vulnerabilities State transition, Immunology, Payload Anomaly Detection
Module 4	Attack trees and Correlation of alerts-Autopsy of Worms and Botnets-Malware detection-Obfuscation, polymorphism-Document vectors
Module 5	Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero-day detection-Insider Threat issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception-Future: Collaborative Security
Textbooks	1. Crimeware, Understanding New Attacks and Defenses, Markus Jakobsson and Zulfikar Ramzan, Symantec Press. 2. The Art of Computer Virus Research and Defense, Peter Szor, Symantec Press.

Soft Computing- SET/CSE/MT/E 317 L T P 3 1 0	
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	1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzyand Soft Computing , Prentice:Hall of India, 2003. 2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications Prentice Hall, 1995.

Blockchain Technology- SET/CSE/MT/E 318	L T P 3 1 0
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.

Internet of Things-SET/CSE/MT/E319 L T P 3 1 0	
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", 1st Edition, Academic Press, 2014.
References	1 Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014. 2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Quantum Computation- SET/CSE/MT/E 320	L T P 3 1 0
Module Name	**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	1.Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. 2. 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.
References	1 Pittenger A. O., An Introduction to Quantum Computing Algorithms