

# SYLLABI

**MTech**

**IN**

**COMPUTER SCIENCE AND ENGINEERING**



**2016**

**Department of Computer Science & Engineering**

**JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY**

**A-B ROAD, RAGHOGARH, DT. GUNA-473226 MP, INDIA**

**TEACHING SCHEME**  
**Master of Technology (M.Tech.)**

**Branch – CSE**

**Year/Sem: Ist Year/Ist Sem**

S. No.	Subject Code	Subject	Core / Elective	L	T	P	Credits
1	14M11CI112	Advanced Computer Networks	Core	3	0	0	3
2	14M11CI113	Advanced Database Systems	Core	3	0	0	3
3	14M11CI114	High Performance Computer Architecture	Core	3	0	0	3
4	14M11CI115	Advanced Algorithms	Core	3	0	0	3
5		DE-I	Elective	3	0	0	3
6	14M17CI171	Software Systems Lab - I	Core	0	0	4	2
		<b>Total</b>		<b>15</b>	<b>0</b>	<b>4</b>	<b>17</b>

**Year/Sem: Ist Year/IIInd Sem**

S. No.	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1	14M11CI212	Advanced Operating Systems	Core	3	0	0	3
2	14M11CI213	Advanced Software Engineering	Core	3	0	0	3
3	14M11CI214	Multimedia Systems	Core	3	0	0	3
4	14M11CI215	Computer System Performance Analysis	Core	3	0	0	3
5		DE-II	Elective	3	0	0	3
6	14M17CI271	Software Systems Lab - II	Core	0	0	4	2
		<b>Total</b>		<b>15</b>		<b>4</b>	<b>17</b>

**Year/Sem: IIInd Year/IIIrd Sem**

S. No.	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1		DE-III	Elective	3	0	0	3
2		DE-IV	Elective	3	0	0	3
3	14M19CI391	Seminar-I	Core	0	0	4	2
4	14M19CI392	Dissertation Part I*	Core	--	--	--	12
		* to be continued in Semester IV					
		<b>Total</b>					<b>20</b>

**Year/Sem: IInd Year/IVth Sem**

S. No.	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1		DE-V	Elective	3	0	0	3
2		DE-VI	Elective	3	0	0	3
3	14M19CI491	Seminar-II	Core	0	0	4	2
4	14M19CI492	Dissertation Part II**	Core	--	--	--	14
		<b>Total</b>					<b>22</b>

**Note-**

1. Dissertation \*\* to be continued from III Semester.
2. Final Evaluation of the Dissertation will be based on the cumulative performance in all III and IV Semesters.
3. It is desirable to have one publication from the Dissertation.

**LIST OF ELECTIVES**

List of Electives for DE-I to be updated from time to time			Core/ Elective	L	T	P	Credits
1	14M14CI132	Artificial Intelligence in Manufacturing	Elective	3	0	0	3
2	14M14CI133	Modern Cryptography	Elective	3	0	0	3
3	14M14MA213	Advance Numerical Techniques	Elective	3	0	0	3
4	14M14PH134	Process Modelling and Simulation of Semiconductor Devices	Elective	3	0	0	3

List of Electives for DE-II to be updated from time to time			Core/ Elective	L	T	P	Credits
1	14M14CI231	Data Mining & Warehousing Techniques	Elective	3	0	0	3
2	14M14CI233	Enterprise Information Systems	Elective	3	0	0	3
3	14M14CI234	Advanced Computer Graphics	Elective	3	0	0	3
4	14M14CI235	Human Aspects of Software Development	Elective	3	0	0	3
5	14M14CI236	Information System and Security	Elective	3	0	0	3
6	14M14CI131	Analysis and Design of Algorithms	Elective	3	0	0	3

<b>List of Electives for DE-III &amp; DE-IV to be updated from time to time</b>			<b>Core/ Elective</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	14M14CI331	Advanced Network Management	Elective	3	0	0	3
2	14M14CI332	Image Processing & Applications	Elective	3	0	0	3
3	14M14CI333	Real Time Operating System	Elective	3	0	0	3
4	14M14CI334	Computation Theory and Applications	Elective	3	0	0	3
5	14M14CI335	Computational Intelligence	Elective	3	0	0	3
6	14M14CI336	Queueing Networks	Elective	3	0	0	3
7	12M1GCI335	Cognitive Science	Elective	3	0	0	3
8	14M14MA231	Mathematical Modelling & Simulations	Elective	3	0	0	3
9	14M14PH131	Quantum Computation & Quantum Cryptography	Elective	3	0	0	3

<b>List of Electives for DE-V &amp; DE-VI to be updated from time to time</b>			<b>Core/ Elective</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	14M14CI431	Computer Vision	Elective	3	0	0	3
2	14M14CI432	Machine Learning	Elective	3	0	0	3
3	14M14CI433	Grid Computing	Elective	3	0	0	3
4	14M14CI434	Swarm Intelligence & Applications	Elective	3	0	0	3
5	14M14CI435	High Performance Parallel Computing	Elective	3	0	0	3
6	14M14CI436	Software Architecture	Elective	3	0	0	3
7	14M14CI437	Storage Networks	Elective	3	0	0	3
8	14M14CI438	Natural Language Processing	Elective	3	0	0	3
9	14M14CI439	Formal Language and Compilation	Elective	3	0	0	3
10	14M14CI440	Voice over IP	Elective	3	0	0	3
11	14M14CI441	Wireless Sensor Network	Elective	3	0	0	3
12	14M14CI442	Digital Forensics and Cyber Crime	Elective	3	0	0	3

# SYLLABI

## Master of Technology (M.Tech.)

### Branch - CSE

#### Year/Sem: 1st Year/1st Sem

##### **14M11CI112 Advanced Computer Networks**

Introduction: Introduction to the Subject and its Relevance. Syllabus. Text Books. Examination. Evaluation and Grading. Overview and Convergence: Overview of Computer Networks. Convergence of Computer and Telecommunication Networks. Generic Network Model: Transmission and Switching. Information Types. Bandwidth Considerations. Integration of Voice and Data, Characteristics of Data, Video and Voice Signals. Switching and Network Types: Packet Switching- Connectionless and Connection Oriented. Circuit Switching and its Comparison with Packet Switching. Characteristics of Data and Telephone Networks. Layered Architecture: Layering Concepts. 7-Layer Model. Functions of Different Layers. Interfaces and Protocols. Standards.

Transmission Control Protocol and Internet Protocol: Internet Protocol. Addressing Scheme. Protocol Details. IPv4 and IPv6. Internet Control Message Protocol. Transmission Control Protocol and its Features. User Datagram Protocol. Applications. Data Link and Network Layer: Data Framing. Error Control. High-Level Data Link Control. Network Layer Protocols and Standards. Local/Metropolitan Area Networks: Local Area Network Types. Topology. Medium Access Control Techniques. IEEE Standards. Physical Level Parameters. Fiber Distributed Data Interface. Distributed Queue Dual Bus. Asynchronous Transfer Mode.

High Speed Networks: High Speed Network Issues. Gigabit Ethernet. Asynchronous Transfer Mode Technology.

Security: Network and Communication Security. Encryption and Decryption Techniques. Firewalls. Some Advances: Simple Network Management Protocol. Voice over Internet Protocol. Network Performance. Queuing Theory, etc.

##### **14M11CI113 Advanced Database Systems**

Simple database applications: Single user, Multi User. Multiple types of multiple users: Review of relational databases- EER model, object oriented model, relational algebra, Transforming data models into database design, determination of data requirements for databases. SQL for database processing, advanced SQL, Ranked queries, joins among relations, advanced database manipulation using SQL and PL SQL. Web enabled database applications: Introduction to PHP, Script elements, Forms, arrays, function and templates, Handling databases, sessions and cookies, File and directory access, Database Access and connectivity.

Robust database applications: Transaction state and properties, Atomicity and durability, concurrent transactions, serializability test, Concurrency-Lock based, time stamp based, validation based, and multiple protocols, multiple granularity, deadlock handling. Robust database applications with large no of concurrent users: Query processing- Measures of query cost, costing of selection operation, sorting, join and other operation, evaluation of expressions, Query optimization- Estimating statistics of expression results, transformation of relational expressions, choices of evaluation plans, materialized view.

Secured Database applications: Database Security - Database security risks, database users and privileges. Authentication, authorization, access control methods, data encryption, Database Recovery- Failure classifications, recovery and atomicity, log based recovery, shadow paging, recovery with concurrent transactions, Buffer management. Multimedia and Mobile databases: Multimedia databases, web-enabled database, temporal databases, Mobile databases.

##### **14M11CI114 High Performance Computer Architecture**

Introduction to VHDL: Implement basic VHDL constructs, Implement modeling structures of VHDL: Behavioral, dataflow, structural, mixed design, use VHDL building blocks: entity architecture, subprograms, package, package declarations, package body, test –Bench, State machine modeling, fault analysis and hazard detection. Functional Organization: Review the concepts of Computer Architecture – RTL, Micro program, Pipelining and ILP, Memory and I/O. Processor and storage hierarchy, system performance, Performance – Benchmarks, Metrics and their Limitations, Fault tolerance, pipelining timing analysis, and area performance analysis.

Performance Enhancements: Branch Prediction, Dynamic scheduling, Speculative Execution (software/hardware), Superscalar Architecture, Out-of-order Execution, and Multithreading, VLIW and EPIC Architectures, Power Aware Computing, SPEC Mark vs. DTMR cache performance. Multiprocessing: Amdahl's Law, Multicore and Multithreaded Processors, Flynn's Taxonomy: Multiprocessor Structures and Architectures, Memory Synchronization and Cache Coherence, Interconnection Networks, Programming Multiprocessor Systems, GPU and

Special-Purpose Graphics Processors. Case Study– Blue Gene, Road Runner. Distributed Systems: Grids, Cluster Computing, Cloud Computing.

#### **14M11CI115    Advanced Algorithms**

Data structures and Algorithms revisited: Sorting, Searching, Hashing– External hashing, Asymptotic analysis. Amortized Analysis - Motivation, Aggregate Method, Accounting Method, Potential Method. Binomial heap and Fibonacci heap: Introduction, Properties, Make heap, Insert, Minimum, Extract minimum, Union, Decrease key and delete operation on Fibonacci heap. Multidimensional Data Structures: Design, Analysis and Applications, Graphs and Greedy method, Container loading, 0/1 knapsack, shortest paths, and spanning trees, Divide and conquer method, Dynamic programming, Backtracking and branch-and-bound methods. Application of Non-linear Data Structures: Splay tree, Treap, Skiplist, B Tree, Red-Black trees. String Matching - Naive String Matching, Finite Automata Matcher, Rabin Karp, Knuth Moris Pratt algorithm. I/O efficient Algorithms - Hierarchical Memory model of computation, Notion of I/O complexity, External Sorting, Design of external memory algorithms to solve some problems. Max-flow min-cut algorithm– Capacity constraint, skew symmetry, flow conservation, residual capacity, Flow network, Residual networks, Ford Fulkerson method, augmenting path, maximum flow, minimum cut.

#### **14M17CI171    Software System Lab-I**

Implement the different operations on Binary Search Trees & Linked List, Stack, Queue. Implementation of String operation like String length, String copy, String concatenation, String comparison, String reverse. Implementation, Design & Optimization of Algorithm for giving Problems. Getting acquainted with the microprocessor architecture using debug. Design & Study the performance of the Ethernet network, Token Ring by using the OPNET simulator. Work with LAN Trainer to study the performance of different topology by applying different protocols like ALHOA, CSMA/CD, CSMA.

Development of Mini Project in Context of Advance Data Structure. Development of Mini Project in Context of Advance Algorithm. Development of Mini Project in Context of Advance Computer Network. Development of Mini Project in Context of High performance Computer Architecture. Development of Mini Project in Context of Advance Database Management System.

#### **14M14CI132    Artificial Intelligence in Manufacturing**

Introduction: Artificial Intelligence - Definition - Components - Scope - Application Areas; Knowledge - Based Systems (Expert Systems) - Definition - Justification - Structure – Characterization. Knowledge Sources: Knowledge Sources - Expert - Knowledge Acquisition - Knowledge Representation - Knowledge Base - Interference Strategies - Forward and Backward Chaining. Expert System Languages: Expert System Languages - ES Building Tools or Shells; Typical examples of Shells. Expert System software for manufacturing applications in CAD, CAPP, MRP, Adaptive control. Robotics, Process control, Fault diagnosis, Failure Analysis; Process Selection, GT etc. Linking expert systems to other software such as DBMS, MIS, MDB. Case Study: Process control and Office automation. Case studies of typical applications in tool selection, Process selection, Part classification, inventory control, Process Planning etc.

#### **14M14CI133    Data Base Management System**

Database driven Interactive software, Database models, Relational algebra, Relational calculus, SQL, PL/SQL, ER & EER Modeling, Data constraints, Data dependencies, Normalization, Transactions, Concurrency, Recovery, Query processing. Client server architecture, Introduction to web enabled and multimedia databases, Introduction to database driven mobile services.

#### **14M14CI134    Modern Cryptography**

Introduction to ciphers: The Shift Cipher, Reduction/Division Algorithm, The One-Time Pad, The Affine Cipher, The Vigenere Cipher. LCMs and GCDs, Kasiski Attack, Expected Values, Friedman Attack. Number Theory: Divisibility, Unique Factorization, Euclidean Algorithm, Multiplicative Inverses, Computing Inverses, Equivalence Relations, Integers mod m, Primitive Roots, Discrete Logs, Euclid's Theorem, Prime Number Theorem, Primes in Sequences, Chebycheff's Theorem, Sharpest Asymptotics, Riemann Hypothesis.

Abstract Algebra: Rings, Fields, Polynomials. Public-Key Ciphers: Trapdoors, the RSA Cipher, Diffie-Hellman Key Exchange, ElGamal Cipher, Knapsack Ciphers, NTRU Cipher, Arithmetica Key Exchange, Quantum Cryptography. Sketches of Protocols: Basic Public-Key Protocol, Diffie-Hellman Key Exchange, Secret Sharing. Oblivious Transfer, Zero-Knowledge Proofs, Authentication, e-Money, e-Commerce. Factorization Attacks: Pollard's Rho Method, Pollard's p-1 Method, Pocklington-Lehmer Criterion. Strong Primes, Primality Certificates.

#### **14M14PH134 Process Modelling and Simulation of Semiconductor Devices**

Goal of modeling and history of device modelling, Fundamental Properties, Poisson's equation, Continuity equation Carrier transport, Heat flow equation. Basic semiconductor equation, Process modelling, Ion implantation, Diffusion Oxidation, Physical parameters modelling, Analytical investigation about basic semiconductor equation, Discretization of the Basic semiconductor Equation including finite difference, finite elements approaches. The solution of the system of nonlinear algebraic equation, Newton's Methods and extension, Iterative methods.

#### **Year/Sem: 1st Year/IIInd Sem**

#### **14M11CI212 Advanced Operating Systems**

Overview of OS - Review of Operating Systems principles like Linux, VxWorks, and Comparative analysis. Design Issues - Layering, Structure: Monolithic, Micro kernel, etc. Merits and demerits of Minix,  $\mu$ COS etc. Communication and Synchronization - Synchronization mechanisms. Process deadlocks. Resource models. Clock synchronization, Local and Global states. Inherent limitations of distributed operating systems. Event ordering. Timestamps. Concurrency control algorithms- Distributed mutual exclusion. Token and non-token based algorithms. Comparative performance analysis. Concurrency control. Device Driver - Char, Block, Network, Serial and USB device drivers. Case studies of Keyboard device driver, HDD device driver, and LAN card drivers. New approach for Hot pluggable USB device drivers for all kind of devices. File Systems - File handling and recovery mechanisms. Case study of FAT, EXT2FS etc. Security - Authentication mechanisms, Nature of Attacks, Secure network communications, Kerberos, etc. Design Studies - Linux, VxWorks, MicroC/OS-II, Spin, Aegis, Mach, etc.

#### **14M11CI213 Advance Software Engineering**

Review of software engineering: Requirement Engineering, Software Process Models, Analysis and Design, UML Diagrams. Software Reengineering: Software reengineering, forward engineering, reverse engineering, program comprehension. PSP and TSP: Time management, Tracking time, Product planning, Project Plans, Defect finding, projecting a defect, Quality: Product and Process quality. Software Metrics: Introduction to Metrics, challenges in Metrics, classification of Metrics. Product Metrics: Metrics for Analysis, Metrics for design, Metrics for code, Metrics for Testing. Process Metrics: Size, cost, effort Estimation, COCOMO Model. Project Metrics: Metric for Quality. Agile Methods: Agile development, Classification of methods, Agile principals, Agile project management, SCRUM, extreme Programming. Advance software Testing: Object Oriented Testing , GUI Testing , Real Time system Testing, Automated Testing, cyclomatic complexity, black box testing, data flow testing, graph based testing, regression testing. Software Security: Software Threats, Software Piracy and authentication, architecture and design of secure software, process of building secure software.

#### **14M11CI214 Multimedia System**

Multimedia Programming- Term Multimedia, Term Media, Characterizing Data Streams. Advanced Object Oriented Programming, Reusability, Synchronization, Expandability, Maintainability. Digital Audio and Video Technology- Audio Technology. Audio Representation on Computers, Speech Output, Speech Input, Speech Transmission. Audio Compression: Differential pulse code modulation, Adaptive differential PCM, Adaptive predictive coding, Linear Predictive Coding, Perceptual Coding, Audio Coders. Text Compression: Static Huffman coding, Dynamic Huffman codes, Arithmetic coding, Lempel-Ziv coding. Image Compression: Graphics Interchange format, Tagged image file format, JPEG Video Compression: MPEG, MPEG4, Audio and Video Synchronization.

Multimedia Database Management Systems- Multimedia object storage, File Retrieval structures, Disk Scheduling, Metadata for Multimedia, Multimedia Data Access, Multimedia Information Modeling, Object- Oriented Modeling, Querying Multimedia Databases.

Multimedia Communication- Standards for multimedia communications. TCP- based system for multimedia streaming, Peer-to-Peer streaming topologies, Distributed Multimedia applications, live/on-demand broadcasting, server bandwidth, distribution control and privacy protection for Internet media delivery, High-End Interactive Television Terminals. Wireless IP networks, wireless video communication, 3G/4G wireless systems. Multimedia applications over Multihop wireless links, World Wide Web. Multimedia Content Analysis- Analysis of individual images, text recognition, similarity based searches in image databases, Audio Analysis, Video Analysis.

#### **14M11CI215 Computer Systems Performance and Analysis**

An overview of performance evaluation: Introduction, Common mistakes and how to avoid them, Selection of techniques and metrics. Measurement techniques and tools: Types of workloads, Art of work load selection,

Workload characterization techniques, Monitors, Program execution monitors and accounting logs, Capacity planning and bench marking, The art of data presentation, Ratio games.

Probability theory and statistics: Summarizing measured data, Comparing system using sample data, Simple linear regression models, other regression models. Experimental design and analysis: Introduction to experimental design, 2k Factorial design, 2kr Factorial designs with replication, 2k-p Fractional factorial design, One factor experiments, Two-Factor full factorial design without replications, Two-Factor full factorial design with replications, General Factor full factorial design with k factors.

Simulation: Introduction to simulation, Analysis of simulation results, Random-number generation, testing random-number generators, Random-variate generation, commonly used distributions. Queuing Models: Introduction to queuing theory, Analysis of a single queue, queuing networks, operational laws, Mean value analysis and related techniques, Convolution Algorithm, Hierarchical decomposition of large queuing networks.

#### **14M17CI271 Software System Lab-II**

Introduction to advance programming languages: C++/Java, Socket programming, Applets, GUI, Java servlets and JSP, Beans. Advanced Algorithms Lab: Programming of advances Data Structures and Algorithms. Data Mining Lab: Programming with Data Mining Tools and Analysis. Advanced Operating System Lab: Programming of Operating System algorithms. Multimedia Systems Lab: Analysis and design of Multimedia tools.

#### **14M14CI231 Data Mining and Warehousing Techniques**

Data warehousing, Data mining, Web Crawling and Web search Introduction. Requirement analysis, Dimensional modeling, Design, Project management, Building and Testing. User data access management, Online analytical Process models, Query Access Architectures, OLAP, MOLAP, ROLAP. Data preprocessing, Data extraction, transformation and loading. Meta data and Metadata Environment. Data warehouse Quality metrics and Security. Linear regression, multiple regression, Usability and Complexity Analysis of Bayesian algorithm, Nearest Neighbor algorithm, Decision Tree based algorithm, Rule based Algorithm. Usability and Complexity Analysis of Agglomerative Hierarchical Algorithm, k-means Partitioning Algorithm, self organizing maps, Multidimensional scaling. Usability and Complexity Analysis of Apriori Algorithm, Sampling Algorithm, Partitioning, Using multiple minimum supports , Rough set approach.

#### **14M14CI233 Enterprise Information System**

Introduction to Integrated Enterprise Information System: Enterprise Architecture Models, Frameworks, Classification of Information Systems, Functional Area Application-Finance, Marketing, HR, Software Enterprise, VLSI Enterprise. Introduction to JAVA: Collection Interfaces, The Collection Classes, The Legacy Classes and Interfaces, Programming Advanced Data Structure using Collection APIs.

Enterprise Application with J2EE: J2EE Architecture, Servlet Lifecycle, Servlet Classes, Threading models, Elements of JSP, Database Access with JDBC, JSP & XML, JAVA Web Services, JAVA Message Services. Developing Enterprise Application using Enterprise JAVA Beans: Three Tier Architecture, Message Driven, Entity Bean, and Session Bean.

Social, Legal, Ethical & Security issues in EIS: Security Architecture, Security Risks and Threats Security Policies, JAVA Cryptography.

Mobile Based Enterprise Application using Java2 Micro Edition: Configuration, Profiles, Architecture, Development Kits, Creating, compiling, running and deploying MIDlet suit, J2ME Wireless Toolkit. Enterprise Information System for software Enterprise: Requirement Management system, Online Defect Tracking System for Software Engineers, Software Testing enterprise System, Documentation Version Management System, Change Management System, Software Project Management System.

#### **14M14CI234 Advanced Computer Graphics**

Introduction: Introduction, Direct Illumination, rendering concepts, lighting, reflectance. Monte Carlo: Global Illumination, rendering equation, comparison of solution methods, Monte Carlo Path Tracing I: Monte Carlo integration, path tracing. Radiosity: Monte Carlo Path Tracing II: sampling strategies, irradiance caching, form factors, solution methods, meshing. Visibility & Texture: visibility events, discontinuity meshing. Texture: texture mapping, resampling.

Image-based modeling rendering: Managing Scene Complexity: occlusion culling, detail elision, imposters, plenoptic function, image-based representations. 3D Modeling: Object Representations: overview of 3D model representations, Mesh Representations: mesh data structures, simplification. Triangle Meshes: multi-resolution meshes, progressive meshes, view-dependent simplification, Mesh Processing: compression, streaming.



Surface Modeling: Parametric surfaces: splines, piecewise polynomial surfaces, subdivision surfaces: subdivision schemes. Volumetric Modeling: Implicit surfaces: blobby models, skeletons, variation implicit surfaces, Volumetric Representations: voxels, volume graphics. Kinematics: articulated figures, inverse kinematics, space-time constraints, Motion Capture: processing motion capture data, retargeting motion. Dynamics: Passive Dynamics: particle systems, spring-mass systems, Active Dynamics: controllers, learning, planning, Wrapup: review and discussion.

#### **14M14CI235 Human Aspects of Software Development**

HCI techniques relevant to studying software development (contextual inquiries, field studies, surveys, lab studies, etc.), Studies of novice programmers (barriers, performance, etc.), Studies of professional programmers (programmer variability, cultural differences, actual practices, questions asked), Studies of the usability of APIs Studies of processes for programming (Agile, Peer, collaboration, test-driven development, etc.), Tools for novice programmers, Tools for making it easier to understand code (Visualization, analyses, etc.), Tools for making it easier to write programs (IDEs, etc.), Programming Languages and Environments that have good usability properties, Tools for making it easier to debug programs, Tools focused on "end-user" development of code (for people who are not professional programmers), End-User Software Engineering (EUSE), Tools for making it easier to capture and use Design Rationale, Documentation tools for making it easier to understand APIs.

#### **14M14CI236 Information System and Security**

Background: Review of networking technologies, Network security threats and counter measures, Cryptography and trust models: Secret key cryptography, Hashes and message digests, Public key cryptography, Network and system security applications: Authentication and security handshakes pitfalls, IP security, Web and E-commerce, Attacks to routing infrastructures and counter measures. Systems and Application Security: OS Security Models, Principals of Web and regular App security, database security. Network Surveillance: Network Attack Traceback and Attribution. Intrusion Detection and Response: What and Why's of IDS. Non repudiation: Anonymity/Pseudonymity/P3P, Case Studies.

#### **14M14CI131 Analysis and Design of Algorithms**

Fundamental Concepts: Model of computation, Features of an algorithm, asymptotic analysis, Amortized Analysis, Proof Techniques. Algorithm Design Techniques: Recursive Procedures, Iterative Procedures, Divide and Conquer, Dynamic Programming, Greedy Approach, Branch and Bound, Backtracking. Network Flow and Matching: Flows and cuts, Maximum Flow, Maximum Bipartite matching, Minimum Cost Flow.

Numerical algorithms: Flows and cuts, Maximum Flow, Maximum bipartite matching, Minimum Cost Flow. Geometric algorithms: Convex hull, closest pair, Intersection of line segments, Polygon triangulation. NP Completeness: Polynomial time and intractability, Space and time complexity, Problem Reductions, NP-completeness of satisfiability.

#### **14M14MA213 Advance Numerical Techniques**

Newton-Raphson Method for two or more variables, Muller's Method, Graeffe's Root Squaring Method, Lin-Bairstow's Method. Least Square Method, Iterative methods for  $Ax = b$ , SOR method, Jacobi Method, Householder's Method for eigenvalues and vectors. Interpolation using Divided Differences, Hermite Interpolation, cubic splines. Orthogonal polynomials, Gram-Schmidt orthogonalization process, Chebyshev polynomials, economization of power series, numerical integration, Romberg integration, Newton-Cotes integration formulae, Gaussian Quadrature. Single step- methods, multi step methods, predictor-corrector method for initial value problems. Finite difference methods for elliptic (Laplace equation), parabolic (heat equation) and hyperbolic equations (wave equation). Method of weighted residuals, Rayleigh-Ritz method, finite element method for one dimensional problem.

#### **Year/Sem: IIInd Year/IIIrd Sem**

#### **14M14CI331 Advanced Network Management**

Overview of Network Management, Managing Enterprises Networks, Network Implementation and Management, Configuration: Infrastructure Components, SNMP, Network Management Problems and Their Solutions, RMON1, RMON2, Management of MPLS Networks, Desktop Management.

#### **14M14CI332 Image Processing and Applications**

Introduction and Digital Image Fundamentals: Digital Image Representation, Fundamental Steps in Image Processing, Elements of Digital image processing systems, Sampling and quantization, some basic relationships like neighbors, connectivity, Distance measure between pixels, Imaging Geometry. Image Transforms: Discrete Fourier

Transform, Some properties of the two-dimensional Fourier transform, Fast Fourier transform, Inverse FFT. Image Enhancement: Spatial domain methods, Frequency domain methods, Enhancement by point processing, Spatial filtering, Lowpass filtering, Highpass filtering, Homomorphic filtering, Colour Image Processing. Image Restoration: Degradation model, Diagonalization of Circulant and Block-Circulant Matrices, Algebraic Approach to Restoration, Inverse filtering, Wiener filter, Constrained Least Square Restoration, Interactive Restoration, Restoration in Spatial Domain. Image Compression: Coding, Interpixel and Psychovisual Redundancy, Image Compression models, Error free comparison, Lossy compression, Image compression standards. Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion based segmentation. Representation and Description: Representations schemes like chain coding, Polygonal Approximation, Signatures, Boundary Segments, Skeleton of region, Boundary description, Regional descriptors, Morphology. Recognition and Interpretation: Elements of Image Analysis, Pattern and Pattern Classes, Decision-Theoretic Methods, Structural Methods, Interpretation.

#### **14M14CI333 Real Time Operating System**

Basic Concepts: Hard versus soft Real Time System, A reference model of Real Time System, Real Time applications. Real Time Scheduling: Clock driven scheduling, Priority driven scheduling of periodic tasks, Scheduling, A periodic and sporadic jobs in priority driven systems. Real Time Operating Systems: Time services and scheduling mechanisms, Basic Operating System Functions, Processor reserves and Resource Kernel, Open System Architecture, Overview of several commercial and general purpose operating systems. Multiprocessor and Distributed real time systems: Model of multiprocessor and distributed systems, Multiprocessor scheduling, Resource access control and synchronization. Resources Access Control: Assumptions on resource and their uses, Resource Contention and Resource Access Control, Non preemptive critical sections, Basic priority inheritance protocol, Basic priority ceiling protocol, stack based, Priority ceiling protocol. Real time Communications: Model of Real Time Communications, Priority based service disciplines for switched networks, weighted Round Robin service disciplines, Medium Access Control Protocols of Broadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocol, Communication in Multicomputer Systems.

#### **14M14CI334 Computation Theory and Applications**

Review of Theory of Computation: Regular Expression, Context free grammar, Pushdown automata, Turing Machines. Finite state Machine Patterns: State object pattern, Basic finite state machine pattern, State driven transition, Owner driven Transition, Layered structure, Interface Organization, Mealy, Moore, Hybrid FSM, Exposed FSM, Encapsulated FSM, static State Instantiation FSM, Dynamic state Instantiation FSM Pattern, Timed Automata Formal software specification methods: Introduction, Specification and requirements, Specification languages and Applications. Tools: Language Emulator, JFLAP, Turing Machine simulator, RAISE.

#### **14M14CI335 Computational Intelligence**

Computational intelligences, agents, example application domains, Representation and reasoning systems, Datalog, syntax and semantics, variables, queries, answers, recursion. Proofs, soundness, completeness, top-down and bottom-up reasoning, function symbols, Searching, graphics, generic search engine, blind search strategies, heuristic search, A\* search. Pruning the search space, search direction, iterative deepening, dynamic programming, constraint satisfaction, consistency algorithms, hill climbing, randomized algorithms. Knowledge representation issues, defining a solution, choosing a representation, semantic networks, frames, primitive and derived relations. Equality, inequality, unique names assumption, complete knowledge assumption, negation as failure. Actions and planning. STRIPS representation, situation calculus, forward planning, resolution and planning. The STRIPS planner, Midterm, Regression Planning. A building situated robots Robot Architectures.

#### **14M14CI336 Queueing Networks**

Introduction to Queueing Theory: Little's Law, Utilization Law, Kendall's Notations, Basic Relations for Birth-Death Processes, Open and Closed Queueing Networks, Product Form Networks, Mean-Value Analysis, Queueing Network Models of Computer Systems. Priority Queueing, Computer Communication Network, Multi-access Systems. Overview of Queueing Network Modelling: Modelling Study, Fundamental Laws, Queueing Network Models Input and Output. General Analytic Techniques: Bounds on performance, Models with one or multiple job classes, Flow Equivalence and Hierarchical modelling. Representing Specific Subsystems: Memory, Disk I/O, Processors. Parameterization: Existing systems, Evolving systems, Proposed systems. Extended Applications: Discrete Time Network, Fluid Approximations, Brownian Networks I, Brownian Networks II, Stability, Scheduling and Control.

### **14M14MA231 Mathematical Modeling and Simulations**

Concepts of mathematical modeling; typical examples of Mathematical Modeling; Mathematical Modeling using Difference Equations, Differential Equations, Random Numbers and Data, Introduction of Simulation Concepts in Discrete- event Simulation, Generation of Random-Number & Random-Variate with Applications, Queuing Models, Simulation Tools and Techniques, Input Modeling, Verification and Validation of Simulation Models, Output Analysis for Simulation Model.

### **14M14PH131 Quantum Computation & Quantum Cryptography**

Introduction & Overview: A brief historical review of basic ideas of classical computation and its scope and limitations. Basic definitions of quantum logic and quantum information. Basic ideas of classical information theory; measures of information (information content and entropy); Maxwell's demon, classical theory of computation; universal computer; Turing machine; computational complexity; uncomputable functions; shortcomings of classical information theory and necessity of quantum information theory. Stern-Gerlach experiment for illustration and existence of electron spin, basic idea of superposition of states. Linear Algebra & Dirac Notation: Dirac notation and Hilbert spaces, dual vectors, linear operators. The spectral theorem, functions of operators. Tensor products, Schmidt decomposition theorem.

Qubits & The Framework of Quantum Mechanics: State of a quantum system, time-evolution of a closed quantum system, measurement in quantum mechanics. Pure and mixed states, density operator, partial trace, general quantum operators. Bloch-sphere representation of single qubit states, qubit rotations, single qubit gates. Quantum Model of Computation: The quantum circuit model, single and multi-qubit operations, universal sets of quantum gates. Efficiency of approximating unitary transformations, implementing measurements with quantum gates. Quantum Algorithms: Probabilistic versus quantum algorithms. Phase kick-back. The Deutsch and Deutsch-Jozsa algorithms. Quantum phase estimation and quantum Fourier transform, error analysis in arbitrary phase estimation. Finding orders, Shor's algorithm for order estimation. Quantum algorithms based on amplitude amplification, Grover's quantum search algorithm and related topics.

Quantum Entanglement & Teleportation: Mathematical and physical conceptions of quantum entanglement, entanglement distillation, entanglement of formation. Entanglement in pure and mixed states. No-cloning theorem for quantum states. Quantum teleportation and quantum communication. Quantum Error-correction: Three qubit bit flip and phase flip codes. Theory of quantum error correction, discretization of errors, independent error models. Construction of quantum codes, quantum circuits for encoding, decoding and corrections. Fault-tolerant quantum computing. Preliminary Quantum Cryptography: Private key cryptography, quantum key distribution, privacy and coherent information, security of quantum key distribution.

### **14M19CI391 Seminar-I**

The objective of Seminar-I is to promote the professional development of graduate students and their ability to formulate the problem/hypotheses. The Ideal work may be characterized by review of relevant literature, concise, and clear oral presentations on their selected topics. Seminar-I is a course requirement where in under the guidance of a faculty member, a student is expected to do in depth study in a specialized area by doing literature survey, understanding different aspects of the problem and arriving at a status report in that area. The Seminar-I is an independent subject, not related to Dissertation, Part-I.

### **14M19CI392 Dissertation, Part-I**

The objective of Dissertation, Part-I is to promote a systematic understanding of knowledge, critical awareness of current problems, originality in the application of knowledge, and the quality of work. The ideal work may be characterized by a new result in design, development & implementation and should have the potential of industrial/scientific acceptance. The first part of the Dissertation should be to determine the interest of students and broadly identify the area of work, finalize the research problem based on literature survey. Also, by now the students should have familiarity with the concepts, tools, techniques required to carry out the Dissertation work. Student is expected to start the research work.

Outcome of Dissertation, Part-I should cover and conclude on the work on identified problem as in the problem statement, the importance, its justification etc. Literature survey, field work, research work etc. Minor variation may be accepted depending upon nature of title.

## Year/Sem: IInd Year/IVth Sem

### **14M14CI431 Computer Vision**

Computer Vision Issues: Computer Vision Issues: Achieving simple vision goals, High-level and low-level capabilities, A range of representations, Image Formation: Images, Image Model: Image Functions, Imaging Geometry, Reflectance, Spatial Properties, Imaging Devices: Photographic Imaging, Sensing Range, Reconstruction Imaging. Early Processing: Recovering Intrinsic Structure, Filtering the image: Template, Finding Local Edges, Range Information from Geometry, Surface orientation from Reflectance Models, Optical Flow. Boundary Detection: Hough Method for curve detection, Contour following, Motion - Motion Understanding, optical flow, understanding of image sequences. Representation of 2D Geometric Structures: Two dimensional geometric structures, boundary representations, region representations, simple shape properties, Representation of 3D structures: 3D: Surface representations, generalized cylinder representations, volumetric representations. Pattern Matching: Graph Theoretic Algorithms, Multiple features, Classification. Case Studies: Optical Character Recognition, Face Recognition.

### **14M14CI432 Machine Learning**

Introduction: Natural vs. machine learning, Types of Learning, Inductive Classification: Concept Learning and General-to-Specific Ordering, Decision Tree Learning: Properties, Top-down Induction, Entropy, Overfitting, Other Issues, Artificial Neural Networks: Perceptron learning, Multilayer N/w, Backpropagation, Applications, Experimental Evaluation: Inductive hypotheses, Types of Tests, Comparing learning Algorithms, Significance Testing, Bayesian learning: Naïve bayes, regression, Generative model and inference, Computational learning Theory: PAC model, Version Spaces, Complexity, Hypotheses Spaces, VC dimension, Instance based Learning: Distance Metrics, K-nearest neighbor and Variations, Evolutionary learning: Genetic algorithms, Fuzzy models, Support vector machine: Separation, Classification, optimization, applications, Other Learning: Reinforcement, statistical, unsupervised, temporal and explanation based learning, Analytical and Inductive learning: Analytical and Inductive learning.

### **14M14CI433 Grid Computing**

Overview and Motivation: The history and evolution of Grid computing, Situating Grid computing, the big picture, Basic concepts of Grid computing and Requirements, Large scale problem solving, Exemplars, Problems, trends and directions. Grid Architectures and Technologies: Nature of Grid architecture, Components of Grid, Layered Grid Architecture: Key Components: Grid Resource Allocation Management (GRAM), Grid FTP protocol, Grid Resource Information Service (GRIS). Resource infrastructure, Open Grid Services Architecture (OGSA), Globus Toolkit and Web Services. Further technologies: Storage Resource Broker, Legion, Condor, Grid Computing Environments, Resource allocation, sharing and discovery. Peer-to-peer systems: Purpose, definition, characteristics, Types of P2P systems, Examples like Gnutella, Chord, Napster, KaZaA, Freenet, neuroGrid, JXTA, Relationship of P2P computing with GRID. Security issues in Grid environment: Introduction to GSI, Grid Applications, New Biology and the Grid, Data Intensive Grids, Applications for high-energy physics, Semantic Grid.

### **14M14CI434 Swarm Intelligence and Applications**

Introduction: Social Insects, Modeling Collective Behavior in Social Insects, Modeling as an interface, from algorithm to Robotics. Ant Foraging Behavior and Application in Network: Overview, foraging Strategies in ANT's, ANT Colony Optimization: The Traveling Salesman Problem, Other Applications of Ant Colony Algorithms to Optimization, Applications to Telecommunications Networks. Cemetery Organization, Brood Sorting, Data Analysis, and Graph Partitioning: Overview, Cemetery Organisation and Larval Sorting, A model of Corpse Clustering and Brood Sorting, Exploratory Data Analysis, Graph Partitioning, Robotic Implementations. Self-Organization and Templates: Application to Data Analysis and Graph Partitioning: Overview, the interplay of self organization and templates, Application. Nest Building and Self-Assembling: Overview, Nest Building in social insects, Model of self-assembly, beyond biology. Cooperative Transport by Insects and Robots: Overview, Cooperative prey retrieval in ANT's, Cooperative Transport by a swarm of robots.

### **14M14CI435 High Performance Parallel Computing**

Parallel programming paradigms, Vectorization, shared-memory and multi-core programming, OpenMP, Multi-threading, Message Passing Interface (MPI), Non-determinism in parallel programs, Parallel debugging, domain decomposition schemes, Communication scheduling methods, Parallel linear algebra and parallel solvers, data structures and abstractions, Parallel algorithms and libraries, Grid computing, Resource allocation models.

#### **14M14CI436 Software Architecture**

Introduction to Software Architecture: Definition of a Software Architecture, Purposes and Functions of a Software Architecture, The Business Case for a Software Architecture, The Overview of the Architecture Development Process, Problems in Building a Software Architecture, Quality Attributes: Definition of a Quality Attribute, Characteristics of a Quality Attribute, Stakeholders and Quality Attributes, A Beginning set of Quality Attributes, Creating a Quality Attribute.

Software Architecture Patterns: What is an Architecture Pattern?, 9 Patterns to Start, Patterns and the Application Domain, Patterns and Software Architecture, Reference Architectures. Building the Architecture: The Software Hardware Split, The Layer Concept of Architecture Building, Build Me a Model!, Starting from a Pattern, Tactics for Specific Attributes, Testing and Validating the Architecture: Review: The Functions of Testing and Validation, The Multiple Audience Problem, Simple Methods of Testing and Validation, A Peak at Formal Methods. Documenting the Architecture: The Functions of Architecture Documentation, The Limits of Documentation, Using Views in Documentation, 7 Rules for Great Documentation. Case Studies and Final Project: This portion of the course incorporates the lessons learned throughout the program and builds in specific examples from your organization.

#### **14M14CI437 Storage Networks**

Introduction to Storage Technology- Data proliferation, Overview of storage infrastructure components, Evolution of storage, Information Lifecycle Management concept, Basic storage management skills and activities. Technologies for Storage Networks - Disk Subsystems Overview, Architecture of Intelligent Disk Subsystems, JBOD: Just A Bunch of Disks, RAID & RAID Levels, Hot Sparring, Hard Disks and Internal I/O Channels. I/O Techniques - DAS, SAN, NAS, evolution, Storage Area Networks (SAN): elements & connectivity, Fibre Channel SAN & Products, IP SAN Technology & Products, IP SAN elements, standards (iSCSI, iFCP, mFCP, FCIP and iSNS), Migration from SCSI and Fibre Channel to IP storage, Network attached Storage: elements & connectivity. Management of Storage Network: Requirements of Management Systems, Management Interfaces, Standardized and Proprietary Mechanisms, In-band & Out-band Management. Storage Virtualization- The concept of storage virtualization, Storage virtualization on various levels of the storage network, Symmetric & Asymmetric Storage virtualization, Performance of SAN virtualization, Scaling storage with virtualization.

#### **14M14CI438 Natural Languages Processing**

Natural Language Processing: applications and key issues, The lexicon and morphology, Phrase structure grammars and English syntax, Part of speech tagging, Syntactic parsing , top-down and bottom-up parsing strategies, Semantics, Word Sense Disambiguation, Semantic parsing, Subjectivity and sentiment analysis, Information extraction, Automatic summarization, Information retrieval and Question answering, Machine translation.

#### **14M14CI439 Formal Languages and Compilation**

Languages And Grammars: Vocabulary and language, Non languages Grammars, Derivations and language of a Grammar, Classification of Phrase Structure Grammars, Recognition of Context Sensitive Languages, Stages of Compilation. Finite Automaton: Equivalence between Finite Automata and Regular Grammars, Extensions of finite automaton (Moore and Mealy Machines). Regular Sets and Regular Grammars: Backward Deterministic Regular Grammars, Recognition Algorithm for Backward Deterministic Regular Grammars, Theorem: Conversion to backward deterministic form, Theorem: Closure properties of regular languages, Pumping Lemma for regular languages Equivalence between regular expressions and regular grammars, Theorem: Converting regular expressions to regular grammars, Theorem: Converting regular grammars to regular expressions, Another Formulation of Regular Languages, Construction of a Lexical analyzer.

Context Free Languages (CFL): Derivations in Context Free Grammars Ambiguity, Recognition of context free languages, Chomsky normal form Theorem: Conversion to Chomsky normal form, Derivation in Chomsky Normal Form and Syntax Analysis, Importance of Chomsky Normal Form, Forward Deterministic Context Free Grammars, Pushdown Automata and context free Grammar. Pushdown Automaton: Top down parsing, Bottom-up parsing, Role of semantic analyzer, Writing a simple type checker. Turing Machines: Turing Machine Model, Representation Of Turing Machine, Language Acceptability By Turing Machine, Design Of Turing Machine, Halting Problem Of Turing Machine, NP Completeness.

#### **14M14CI440 Voice over IP**

VoIP Systems, Components, Standards: Terminals, Voice in IP Packets, Soft switches/SIP Servers/Call Managers, Media Servers and Unified Messaging, Gateways, LANs and WANs, Key VoIP Standards. VoIP Architectures: Internet Telephony, Managed-IP Telephone Service, VoIP for Businesses and Organizations, IP Phone Features and

Uses. VoIP Protocols: Session Initiation Protocols, MEGACO, H.248, Real Time Protocol, RTCP. Understanding VoIP Technology and Networking. Overview, Voice Packetization, Measuring Voice Quality, Factors Affecting Voice Quality, Codecs, Compression and the G.729 codec, The VoIP Protocol Stack. Carrier VoIP Networks, Services and Interconnect. Carrier Services Offered, MPLS and Quality of Service, VPNs and secure call paths, Session Border Controllers, Megaco/H.248 services, Types of managed services available, Gateway configurations and options, IP-level connectivity: cost savings. Voice over IP security, Internet Protocol (IP), User Datagram Protocol (UDP), Real-Time Transport Protocol (RTP), RTP Payload, Packet Analysis, Network Security Issues and Solutions.

#### **14M14CI441 Wireless Sensor Network**

Introduction of ad-hoc networks: Key definitions of ad-hoc networks, link quality, shadowing and fading effects, unique constraints and challenges, driving applications, wireless communications /radio characteristics. Wireless Sensor Networks: Introduction, various industry standards, motes, scheduling sleep cycles, data gathering. Security. LR-WPAN (IEEE 802.15.4): Introduction, PHY Specification, MAC Specification, ZigBee, Applications. Routing Protocols: Issues in designing routing protocols, classification of routing protocols, Routing protocols. Modeling sensor network: Introduction to QualNet simulator, creating scenario, configuring scenario, scenario statistics, packet tracer, file editor. Applications of Ad-Hoc/Sensor Network and Future Directions.

#### **14M14CI442 Digital Forensics and Cyber Crime**

Introduction to Digital Forensics, Cybercrime and Criminals, Digital Trails and Storage Systems, Hidden Evidences, Network Forensics, Image Forensics, Investigative Framework Methods, Cybercrime Methodologies, Digital Forensics Tools, Field Acquisition Methodology, Field Acquisitions of Electronic Media, Introduction to IT act.

#### **14M19CI491 Seminar-II**

Seminar-II is a course requirement where in under the guidance of a faculty member, a student is expected to do in depth study in a specialized area by doing literature survey, understanding different aspects of the problem and arriving at a status report in that area. While undergoing a Seminar-II course, the student is expected to learn investigation methodologies, study relevant research papers, correlate work of various authors/researchers critically, study concepts, techniques, prevailing results etc., analyze it and present a Seminar-II report. The Seminar-II is an independent subject, not related to Seminar-I and Dissertation, Part-II.

#### **14M19CI492 Dissertation, Part-II**

Dissertation, Part-II should be seen in continuation with Dissertation, Part-I. In this part needful implemented in desired coding languages should be performed after several experiments and analysis of its results should be performed to achieve the objective of Dissertation. The Dissertation work may involve analytical studies/computational work/experimental findings fabrication/ testing of hardware and their combination or any other forms as required.